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TWENTY-SEVENTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

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MEMBERS OF THE BOARD.

1895–1896.

HENRY P. WALCOTT, M.D., *Chairman*, ... of CAMBRIDGE.
FRANK W. DRAPER, M.D., ... of BOSTON.
GERARD C. TOBEY, ESQ., ... of WAREHAM.
JAMES W. HULL, ... of PITTSFIELD.
CHARLES H. PORTER, ... of QUINCY.
JULIAN A. MEAD, M.D., ... of WATERTOWN.
HIRAM F. MILLS, C.E., ... of LAWRENCE.

Secretary.

SAMUEL W. ABBOTT, M.D.

Engineer.

X. H. GOODNOUGH, C.E.

CONTENTS.

GENERAL REPORT.

The contents of the present volume comprise a report of the general work of the State Board of Health for the year ending Sept. 30, 1895, and of that which relates to Water Supply and Sewerage for the calendar year 1895.

This first portion, the general report, paged in Roman numerals, includes a brief statement of the work done under the statutes which define the work of the Board, and contains a summary of the vital statistics of the State for the year 1894.

The second part of the report, paged in Arabic numerals, contains the fuller details of the work of the Board, under the acts relating to Water Supply and Sewerage, Food and Drug Inspection, Reporting of Infectious Diseases and such papers relating to special topics as the Board has deemed it desirable to publish.

The following members comprised the Board in 1895: —

HENRY P. WALCOTT, *Chairman.*

FRANK W. DRAPER.	GERARD C. TOBEY.
HIRAM F. MILLS.	CHARLES H. PORTER.
JAMES W. HULL.	JULIAN A. MEAD.

Dr. J. A. Mead of Watertown was appointed in October, 1895, to fill the place made vacant by the death of Dr. J. W. Hastings. Hiram F. Mills' term expired in May, 1895, and he was reappointed for seven years.

During the year 1895, in addition to the regular routine work of the Board, the following special lines of work have been prosecuted: —

Under the provisions of chapter 426 of the Acts of 1894, the contract made with the Eastern Dredging Company for the purpose of dredging certain portions of the Concord and Sudbury rivers was carried to completion under the direction of the Board.

Under the organic act creating the Board and requiring it to "take cognizance of the interests of health and life among the citizens of the Commonwealth," the Board has provided a continuous supply of antitoxin, for use throughout the Commonwealth, for the purpose of diminishing the mortality from diphtheria, and in connection with the same work, has organized a bacteriological department for the purpose of experimental and executive work in the investigation of infectious diseases.

The duties of the Board as defined by the statutes have not only been increased but have also been changed in their character since the establishment of the Board in 1869. At that time the work of the Board as set forth in the organic law of June, 1869, was entirely of an advisory nature.

The first act of the Legislature giving to the Board executive powers was the offensive trade act of 1871, whereby the Board was authorized, after due notice and hearing, "and if, in the judgment of the Board, the public health or the public comfort and convenience so required," to order parties to cease and desist from further carrying on such trades or occupations.

By an act of 1878 authority was given to the Board to "have general supervision of water supplies" and to investigate the pollution of them and its causes. It was also empowered to issue orders for the prevention of such pollution. This act was repealed in 1884; but in 1886 another statute was enacted, the scope of which was much broader and more effective in its operation, since it not only authorized the Board to make experiments and investigations in the line of water and sewage purification, but made it incumbent upon all cities, towns, corporations, firms and individuals to seek and obtain competent advice before introducing systems of water supply and sewerage. Liberal appropriations were provided for carrying out its provisions.

In 1882 an act was passed to prevent the adulteration of food and drugs and conferring on the Board the authority to enforce the same. The operations of the Board under this act have been reported in each of the annual reports of the Board during the past thirteen years.

Other acts of minor importance have from time to time been enacted, increasing gradually the executive functions of the Board while its advisory powers have not been diminished. Among the

statutes of this character may be named the act relating to ice supplies, the supervision of crematories and the act giving to the Board co-ordinate powers with local boards of health in the prevention of the spread of contagious diseases.

Infectious Diseases.

No serious epidemic occurred during 1895. So far as can be learned from the returns of infectious diseases made to the Board under statutory provisions *diphtheria* had increased slightly over the prevalence of the previous year, but in consequence of improved methods of treatment had not proved so fatal as in former years. The deaths from *scarlet fever* were much fewer than those of either 1893 or 1894, those from *typhoid fever* were slightly less than those of 1893 or 1894, and those from *measles* were greater than those of 1894 but less than those of 1893.

Small-pox.

During the year 1895 not a single death from small-pox has been reported to the Board, and there was but one recorded case of illness from this disease, as compared with a total of 185 cases and 32 deaths in the previous year. Had this single case been cared for in the State where the disease originated, as ought to have been done, we should have been able to record an absolute immunity from small-pox throughout the year. The patient in this case was a student at Yale College, where he was taken ill and was allowed to return to his home in Massachusetts, travelling through two States in public conveyances. Had unvaccinated persons or those not recently vaccinated been exposed to him on the way, the consequences might have proved disastrous.

The facts in this case are presented in conformity to the usual blank form employed in the reports of recent years.

Number.	Place.	Date of Report.	Nationality.	Age.	Sex.	Occupation.	Vaccinated.	Number of Scars.
1	Andover.	March 8	United States.	18	M.	Student.	Yes.	2

Other States and Provinces. — While Massachusetts was so nearly exempt from the invasion of small-pox, other States suffered consid-

erably from its presence during the year. In compliance with the interstate resolutions adopted at Toronto in 1886 notices were received from the following States and provinces with reference to the existence of cases of small-pox during 1895, the sum total being at least 1,348 cases: In Maine 1 case, New Hampshire 19, Connecticut 4, Rhode Island 1, New York 2 (also others, the number not stated), Pennsylvania 327, Maryland 60, Ohio 205 (chiefly in Cincinnati), Michigan 45, Illinois 7, Wisconsin 379 (chiefly in Milwaukee), Missouri 267, Tennessee 3, Minnesota 4, Alabama 1, Oklahoma 7, Ontario 16; total, 1,348.

Notices were also received four times during the year from the immigration office at New York of the arrival of the following steamers with cases of small-pox on board: the "Ems" from Bremen, May 28; the "München" from Bremen, June 19; the "Marsala" (mostly Greeks), October 6; the "California" (mostly Italians), December 3.

The names of immigrants on these steamers destined for Massachusetts, with the places of destination, were also forwarded, and were immediately transmitted by the Board to the local boards of health in the cities and towns to which such immigrants were bound.

Typhoid Fever.

The number of requests which have been made for the assistance of the Board in investigating the causes of typhoid fever has materially lessened within the past two years, the cause being undoubtedly due in a great measure to the continuous introduction of new and purer water supplies for domestic use in cities and towns, and the adoption of methods of protecting existing water supplies from pollution and the purification of certain waters by filtration.

The mortality from typhoid fever in 1894 was only 3.1 per 10,000 of the population.

The following figures represent approximately the mortality from this disease in the different counties of Massachusetts in 1894 per 10,000 of the population living in each county. They show not only a lessened mortality as compared with the figures of earlier periods, but also a greater uniformity in the different counties.

Death Rate per 10,000 Living from Typhoid Fever in Massachusetts (by Counties), 1894.

Barnstable, ...	2.2	Hampshire, ...	3.3
Berkshire, ...	5.3	Middlesex, ...	3.5
Bristol, ...	2.9	Nantucket, ...	0.0
Dukes, ...	2.4	Norfolk, ...	2.5
Essex, ...	2.7	Plymouth, ...	2.3
Franklin, ...	3.2	Suffolk, ...	2.7
Hampden, ...	2.3	Worcester, ...	3.3
The State, ...			3.1

One of the most common means by which typhoid fever is spread among the population is the milk supply. Epidemics of this character have been investigated by the Board in recent years in Cambridge, Somerville, Woburn, Springfield, Marlborough and Newton. Three such epidemics in different years have occurred in Cambridge, all of them apparently due to infection of the milk supply, either at its source upon the producing dairy farms or at the place of collection for distribution in the city. Hence the importance of securing the greatest care in preventing the occurrence of the disease among persons employed either at the dairies or at the places where the milk-cans are handled and cleaned, at the final place of distribution. No person who has the slightest symptoms of typhoid fever should be allowed to engage in these occupations until complete recovery has taken place. Mild or "ambulant" cases are more dangerous than severe cases, in which the sick are confined to bed, since the former are far more liable to infect the milk supply, as has been found in the investigations conducted by the Board.

The following rules recommended by Dr. Russell, senior medical officer of health of Glasgow, would, if everywhere enforced upon dairy farms, diminish very greatly the prevalence of typhoid fever in our cities and towns: —

1. The first and foremost requirement is absolute cleanliness in all the details of dairy work.

2. The cow stable should be of ample size, capable of thorough and frequent cleaning; it should be well lighted, preferably by sunlight, and should be well ventilated.

3. To ensure the greatest freedom from milk infection, the farmhouse should be separated from the buildings used for dairy purposes.

4. No person who is suffering from an infectious disease (or one which conveys any suspicion of infection), or who has been in any way in communication with an infected person or thing, should engage in the milk business.

5. The milk of sick animals, or of those which have suspicious eruptions about the udder or teats, should not be sold for food for human beings.

6. The udder and teats, if soiled, should be washed before milking; warm water, soap and towels should be at hand for the use of milkers, who should be instructed to use them before milking.

7. Healthy cattle, healthy attendants, and, above all, perfect cleanliness in dairy work mean money both to the producer and to the retailer of milk.

The following table presents the statistics of mortality from typhoid fever in the cities of Massachusetts from 1871 to 1894, with the mean annual death rates from this cause in five-year groups.

The table shows a notable decrease in the mean annual death rate from typhoid fever in the four years 1891–94, as compared with the period immediately preceding.

Deaths and Death Rates per 10,000 Living, from Typhoid Fever, in Cities of Massachusetts, 1871–94.

	1871-1875.		1876-1880.		1881-1885.		1886-1890.		Deaths.						
	Deaths.	Mean Annual Death Rate per 10,000 Living.	Deaths.	Mean Annual Death Rate per 10,000 Living.	Deaths.	Mean Annual Death Rate per 10,000 Living.	Deaths.	Mean Annual Death Rate per 10,000 Living.	1891.	1892.	1893.	1894.	Total Deaths, 1891-94.	Mean Annual Death Rate for 4 Years.	Total Deaths, 24 Years.
Boston,	1,145	7.7	690	3.9	952	5.1	818	3.9	152	137	136	137	562	2.4	4,167
Worcester,	176	7.8	131	4.9	106	3.3	109	2.8	16	17	30	31	94	2.1	616
Lowell,	221	9.8	117	4.3	243	7.9	396	11.2	78	77	55	51	261	6.4	1,238
Fall River,	176	9.8	152	6.4	174	6.6	209	6.4	49	27	18	31	125	3.1	836
Cambridge,	124	5.7	55	2.2	103	3.7	116	3.6	17	15	18	28	78	2.1	476
Lynn,	118	7.8	72	4.1	109	5.2	56	2.2	12	13	13	11	49	1.7	404
Lawrence,	190	11.9	122	6.6	144	7.4	233	11.2	55	50	39	25	169	7.0	858
Springfield,	214	14.8	86	5.3	117	6.6	88	4.3	16	39	17	15	87	3.6	592
New Bedford,	99	8.4	50	3.8	62	4.1	71	3.8	9	15	29	13	66	2.8	348
Somerville,	69	7.6	33	2.8	45	3.3	49	2.8	13	14	13	14	54	2.4	250
Holyoke,	157	23.3	77	8.1	159	12.8	105	6.6	25	16	10	7	58	3.1	556
Salem,	87	6.9	61	4.6	66	4.7	59	4.0	9	18	17	11	55	3.4	328
Chelsea,	86	8.7	36	3.4	37	3.1	35	2.6	9	10	6	7	32	2.2	226
Haverhill,	46	6.6	40	4.8	52	5.2	59	4.8	7	13	13	8	41	2.8	238
Brockton,	43	9.2	14	2.3	41	4.8	46	3.8	11	8	3	7	29	1.9	173
Taunton,	65	6.7	34	3.3	59	5.3	58	4.7	3	9	7	8	27	2 1	243
Newton,	20	2.8	25	3.0	31	3.4	44	4.0	7	4	4	10	25	1.9	145
Malden,	25	5.5	31	5.4	21	3.0	33	3.3	6	6	5	12	29	2.2	139
Fitchburg,	32	5.4	17	2.8	18	2.6	31	3.3	5	–	5	5	15	1.2	113
Gloucester,	51	6.3	34	3.8	38	3.7	25	2.2	3	3	5	3	14	1.1	162
Waltham,	13	2.7	8	1.5	20	3.0	17	2.0	3	5	2	2	12	1.2	70
Pittsfield,	56	9.6	29	4.5	34	4.9	40	5.0	5	6	5	5	21	2.2	180
Quincy,	19	4.6	21	4.3	27	4.8	37	5.1	5	7	11	7	30	3.2	134
Northampton,	46	8.7	19	3.3	29	4.6	22	3.2	2	3	6	4	15	1.9	131
Chicopee,	63	12.6	35	6.5	48	8.4	43	6.7	9	24	10	3	46	6.0	235
Newburyport,	29	4.5	31	4.6	22	3.2	17	2.5	5	3	7	6	21	2.9	120
Marlborough,	27	6.4	20	4.3	20	3.8	32	5.2	4	3	7	10	24	3.3	123
Woburn,	20	5.7	10	2.0	14	2.5	24	3.8	7	8	4	5	24	3.5	98
Medford,	11	3.6	12	3.4	11	2.6	11	2.2	3	2	6	3	14	2.2	59
Everett,	6	4.1	2	1.0	9	3.6	14	3.3	4	1	4	3	12	1.6	43
Beverly,	18	5.2	13	3.3	10	2.3	10	2.0	2	3	1	2	8	1.4	59
Totals,	3,458	8.2	2,077	4.2	2,821	5.1	5,907	4.5	551	556	506	484	2,097	2.8	13,360

Malarial Fever.

In addition to the appearance of malarial fever at different points in the State, as detailed in previous reports of the Board, reports have been received by the Board during the past year relative to its appearance in two additional localities, at North Saugus and at Uxbridge.

Notice of its appearance at North Saugus came to the Board in the form of a petition, stating that the city of Lynn had constructed reservoirs in North Saugus for the storage of water, and was about to build another, also that malarial fever had been prevalent in that village since their construction. The petitioners therefore requested the Board "to investigate the matter and to take such action as may be necessary." With a view to affording relief to the petitioners the Board caused an investigation to be made at North Saugus. A house to house visit was made, which resulted in the finding, among a population of about 200 persons, that there had been 21 cases of intermittent fever in 1894 and in the first six months of 1895 there were 13 more. It was also stated that there had been many more cases in 1892 and in 1893. Five households had escaped, mostly on higher ground.

In compliance with this petition the Board held a hearing in August, 1895, at which the board of health of Saugus was represented, together with other citizens of that town and the superintendent of the water works of Lynn. As a result of the hearing, and in view of the facts elicited upon the petition relative to the construction of a new reservoir by the Lynn water board in North Saugus and the effects of such construction on the health of the adjacent community, and in consideration of the methods described by the constructing engineer and the superintendent of said water board with reference to the preparation of the proposed basin and its connections, it was voted "that the State Board of Health deems further action on its part with reference to the new reservoir unnecessary, under existing conditions."

Later in the year information was received that malarial fever was prevailing in Uxbridge, and a request was received from the local board of health of that town that the State Board would investigate the same. An agent was sent to Uxbridge and the investigation is in progress at the time of writing this report.

Consumption.

In keeping with the progress of medical science, and especially with the important discoveries which have been made in the history of infectious diseases, their causes and prevention, the methods of detecting the existence of consumption and the measures taken to prevent its spread form an important part.

Improvements in ventilation in the hygiene of industrial operations, the proper selection and inspection of the food supply, the selection of improved climatic conditions, the management of dust in the household and workshop, and above all in the proper disposal or destruction of the sputa of the sick, all have without doubt had a marked effect in steadily diminishing the mortality from this destructive disease.

In the last annual report (page lxxv *et seq.*) a summary of the vital statistics of consumption was presented, in which its steady diminution during a period of nearly a half century was shown.

With a view of diffusing popular information upon the best methods of preventing tuberculosis the Board issued the following circular in January, 1895, which was distributed throughout the State to such persons (chiefly physicians and boards of health) as would be most likely to appreciate its value and place the circular where it would prove useful in the prevention of the disease.

A Circular of the State Board of Health relative to Tuberculosis or Consumption and the Best Means for Preventing It.

The object of the State Board of Health in issuing the following circular is to furnish information (1) as to the nature of pulmonary consumption, (2) the conditions which favor its spread, and (3) the best methods of preventing it.

1. — *As to the Nature of Consumption.*

Consumption is the most destructive disease of New England, the number of persons annually dying from this cause in Massachusetts amounting to nearly six thousand. Modern research places it among infectious diseases.

The specific virus or poison of the disease consists of a minute germ, the "bacillus of tuberculosis," which exists in the tissues and expectoration of the sick, and which may in various ways enter the bodies of the well and reproduce the disease in them. In the proper care and disposal of the expectoration of the sick, it is probable, lies one of the chief methods of preventing the spread of the disease.

2. — Conditions which favor the Spread of Consumption among Human Beings.

Defective ventilation. One of the chief conditions which is favorable to the production of consumption is the continuous and habitual breathing of unrenewed air. Consequently, in workshops, factories, school rooms, public buildings, halls, churches, and the inhabited apartments of dwellings and tenement-houses the absence of adequate means of ventilation favors the spread of consumption.

Dampness of soil on which the house stands, and dampness of the immediate neighborhood are favorable conditions for the production of consumption. The occupancy as living or sleeping rooms of apartments which are constantly damp or are partly or wholly underground, undoubtedly has a similar effect.

Overcrowding in dwellings, in factories, and in workshops where men and women work for several hours each day, is also a favorable condition for spreading the disease. Density of population increases the liability to this disease. Observations in Massachusetts extending over a period of twenty years (1871–90) show that the deaths from consumption in densely settled districts, as compared with those in sparsely settled districts of the State stood in the ratio of 1,000 deaths in the former to 727 in the latter.

Another factor which favors the spread of this disease is the presence of *dust* in the air of apartments, factories, mills and workshops. Hence occupations or trades in which men, women or children are exposed to the inhalation of irritating dust increase the liability to contract the disease among such operatives. An examination of the reports of the Registrar General of England for several successive years shows that fishermen, who are of all classes the least exposed to dust inhalation, are also comparatively exempt from consumption.

Insufficient and badly selected food. While the influence of improper and insufficient feeding upon the predisposition to consumption is not so directly proven as are the effects of certain other conditions, there is yet sufficient evidence to show that a restricted diet or one composed exclusively of single elementary constituents, as for example, the starches alone, and these in too limited quantities, probably predisposes to consumption.

Intemperance in the use of alcoholic stimulants has also been shown to act in the same direction.

Undue physical or mental strain, overwork, worry and anxiety, and the prolonged suckling of infants (beyond ten or twelve months) are conditions contributing to the same end.

3. — Preventive Measures.

Having the foregoing predisposing conditions in view, the measures which are essential for the prevention of this disease may be more clearly understood.

1. *The prevention of overcrowding.* In tenements and in dwelling-houses the prevention of overcrowding diminishes the liability to contract tubercular diseases among the occupants.

Hence the adoption of measures which shall counteract the effect of overcrowding is desirable. Ventilation is one of the most efficient of such measures. Adequate ventilation should be provided in all factories, halls, school-houses and other buildings in which people assemble in considerable numbers. Simple methods of ventilation in the living and sleeping rooms of dwellings are also essential to healthy living. Open fireplaces, movable transoms in sleeping rooms, provision for admitting fresh air at the windows by special means are all useful precautions.

2. *Household as well as personal cleanliness* is essential to the prevention of consumption. The removal of dust from floors should be practised and care should be taken that such dust is removed by such means as will ensure the least diffusion through the air of rooms during their occupancy.

3. *Occupations.* The selection of a healthy occupation is a matter of no small importance.

Sedentary occupations in ill-ventilated apartments and those which expose the workman to the inhalation of dust should be avoided. Different sorts of dust vary in harmful effects. The sharp dust produced in the grinding of needles and steel tools and in the mining of metals is especially irritating, and the mortality from consumption among operatives in such industries is high. Operatives engaged in such occupations may diminish the liability to harm by wearing "respirators" over the mouth and nose, while at work.

In several factories where consumption had made serious inroads upon the operatives, the adoption of measures for the prevention of a dusty atmosphere secured a marked diminution of the prevalence of this disease among the workmen employed in them.

Regular daily exercise in the open air is of the first importance for all persons who are engaged in sedentary occupations.

The owners and superintendents of *factories*, *mills* and *workshops* can accomplish much toward the prevention of tuberculosis among the operatives by the introduction of adequate systems of ventilation and heating, and by the use of hard, smooth floors without cracks or crevices.

The dust should be removed from the floors at night, after working hours, and not during the occupancy of the workrooms. The use of moisture in the removal of dust, and careful wiping with damp cloths is preferable to sweeping up the dust when dry. Spitting upon the floor should be forbidden.

4. *Food.* As an essential requisite to the prevention of consumption, a diet of sound, wholesome food, in which the chief elementary forms of nutriment are harmoniously combined (the fats, starches and proteids) is necessary. Such a diet should consist mainly of bread and the various

cereals with butter and other fats in generous measure, together with meat, fish and fruits. This does not imply a luxurious or expensive diet, but rather one that is nutritious and easily digested.

The question of the effect of the use of the *meat* and *milk* of *tuberculous animals* does not yet appear to be so well settled as to admit of an unqualified conclusion.

In the absence of absolute and definite evidence, it is therefore desirable that the *meat* of all suspected animals should be cooked thoroughly before using it as food. The *milk* of such animals should be entirely excluded from the food supply.

5. *Overwork*, *anxiety*, *worry* and *exhaustion* should be avoided. Mothers should be advised to *wean suckling infants* by the end of the first year.

Disposal of Sputa.

6. With reference to those who are sick with consumption or tuberculosis, and especially with reference to the possibility that their presence among other human beings may prove a source of danger on account of infection, the following recommendation as to the disposal of the expectoration of consumptives should be especially noted.

Observation and experiments have demonstrated the fact that in this expectoration (especially when dried) lies the chief danger of infection, and hence its proper disposal becomes a matter of prime importance. Therefore, sputa should never be allowed *to become dry*, and should be destroyed as quickly as possible. Consumptives should be instructed not to expectorate about rooms, in streets or highways, in railway or street cars, or in vehicles of any sort, but should spit into rags which can be burned, or into cups or other receptacles containing a little water or other material which may be thoroughly disinfected before the same is allowed to pass into the drain or sewer. Such receptacles should be cleansed with boiling water.

A healthy person should not sleep in the same room with a consumptive.

Disinfection.

7. Sputa may best be burned when deposited upon pieces of cloth or rags; and when put into cups or receptacles holding water the whole should be disinfected with a saturated solution of carbolic acid, which may be obtained of any reliable druggist.

Disinfection should be practised in the case of rooms or apartments which have been vacated by consumptives or those in which such persons have died. There is a growing belief, supported by observation, that rooms which have been inhabited by consumptive families may become permanently infected, and ought not to be occupied until radical measures have been taken to cleanse and disinfect them. Each room vacated by a

tuberculous patient should be disinfected and especially the floor and lower parts of the walls. For this purpose washing the floor and all woodwork with a corrosive sublimate solution, one part to one thousand (about one teaspoonful to a gallon of water) should be practised, and the bed and clothing of the last occupant should be submitted to steam disinfection or to boiling water. Strong soapsuds also have efficient disinfecting power, and may be used for washing floors and woodwork. The disinfection should be thoroughly done, but especially so in cases where the habits of the consumptive in regard to disposal of his sputa have been careless.

As a means of spreading information upon this important subject, local boards of health can undoubtedly accomplish much toward the prevention of consumption, by issuing a circular like the following: —

The Prevention of Consumption.

Consumption is the most destructive disease of New England, the number of persons dying annually from this cause in Massachusetts amounting to nearly six thousand.

The disease is infectious, and can be communicated from one person to another. The chief danger exists in the expectoration of the sick, and if this expectoration is carefully destroyed little danger need be feared.

Consumptives should be instructed not to spit upon the floors of rooms, public halls, street and railway cars, and other vehicles, nor in the streets, but into pieces of cloth, or receptacles made for the purpose, containing water, or a saturated solution of carbolic acid (one part of carbolic acid crystals to about fifteen parts of water). Such bits of cloth should be destroyed by fire, before the sputa become dry, and other receptacles should be cleansed with scalding water, their contents having been destroyed or otherwise carefully disposed of. Handkerchiefs which may have been used from necessity should be boiled half an hour before washing.

A healthy person should not sleep in the same room with a consumptive.

Remember that sputa must never be allowed to become dry.

Office of the State Board of Health, Boston.
January, 1895.

Local Boards of Health.

Nearly fifty years ago (1850) the sanitary commission of Massachusetts advised the obligatory appointment of boards of health in every city and town in the State, and after the establishment of the State Board of Health in 1869 this Board frequently called attention to the need of legislation having this end in view. But not until 1877 was legislation enacted requiring such boards to be appointed as a compulsory measure, and even then the requirement applied to cities only. The Board has from time to time urged the necessity of further legislation requiring similar action on the part of towns, and especially in the case of those having large populations.

No substantial advance has been made in this direction, however, until the enactment of a law in 1894, of which the following is a copy. This statute (chapter 218, Acts of 1894) was amended later in the session, by the same Legislature, so that the amended act reads as follows: —

[Chapter 218, Acts of 1894, as amended by chapter 473, Acts of 1894.]

An Act providing for the election of boards of health in towns.

Section 1. Every town in the Commonwealth may elect a board of health by ballot at the annual meeting of the town, or at a meeting legally warned for the purpose, consisting of three persons, to serve, one for the term of three years, one for the term of two years and one for the term of one year, beginning with the first Monday in April then next ensuing and until their respective successors are chosen and qualified; and thereafter such town shall, at its annual town meeting, choose in the same manner one person who shall hold office for three years from the first Monday of April then next ensuing, and until another is chosen and qualified in his stead. If no such board is chosen the selectmen shall constitute such board of health.

Section 2 was repealed by chapter 473 of 1894.

Section 3. In each city and town having a population of more than five thousand inhabitants, as determined by the last census, at least one member of said board shall be a physician, and the board shall send an annual report of the deaths in such town to the state board of health. The form of such reports shall be prescribed and furnished by the state board of health.

Section 4. Section three of chapter eighty of the Public Statutes is hereby repealed. Sections two, twenty-one, twenty-eight, twenty-nine, thirty, thirty-one, thirty-two, thirty-three, thirty-four and thirty-five of chapter eighty of the Public Statutes, and sections one and two of chapter three hundred and thirty-eight of the acts of the year eighteen hundred and eighty-seven, are hereby amended by striking out the words "or health officer," wherever the same occur therein. [*Approved April 7, 1894.*

The formation of an organization known as the Massachusetts Association of Boards of Health has proved a decided stimulus to local boards in consequence of the advantages secured to its members by means of mutual discussion of the many questions which are constantly occurring in the work of municipal sanitary administration. The members of this organization consist mainly of the members of local boards of health, and of such other persons as are especially interested in public hygiene. Meetings have been held quarterly during the past five years or more, and at each meeting

topics relative to the work of municipal boards have been presented for discussion. Committees have been appointed to confer with legislative health committees with reference to matters of importance which appear to require further legislation.

The association publishes a quarterly journal in which its transactions appear.

Offensive Trades.

No complaints were made to the Board during the year under the provisions of the acts relating to offensive trades, and consequently no hearings were held. The board of health of Newburyport requested the advice of the State Board in regard to a rendering establishment in that city, situated at some distance from the populous part of the city. The secretary conferred with the secretary of the local board, and on visiting the establishment in question found it in an extremely filthy condition, both internally and externally, some thirty or forty carcases of horses in different stages of decomposition lying unburied upon the surface of the ground, while many others, insufficiently buried, had been uncovered by dogs.

Information was received that the premises were subsequently put in good condition and that no further complaints had been made in relation to the same.

Local Nuisances.

A very considerable part of the correspondence received by the Board consists of letters from individuals, or of petitions signed by greater or less numbers of citizens, requesting the State Board to abate local nuisances existing in cities and towns. Often such letters or petitions call the attention of the State Board to the fact that the local board of health has been requested to abate the nuisance but has either refused or neglected to attend to the matter.

So frequent has this class of correspondence become that the State Board has issued a circular which is used as a reply to letters of this character, calling attention to the fact that the State Board has no power or authority to abate an ordinary local nuisance, but that ample power is conferred upon the local board of health to take all proper measures in such cases. If the local board of health refuses or neglects to comply with the request of the petitioners, then the matter may be referred to the county commissioners under the provisions of chapter 80, sections 36, 37 and 38, but not to the State Board of Health.

This statute, however, does not prevent the State Board from consulting with and advising local boards in regard to the disposal of local nuisances whenever such action is necessary.

Statistical Summaries of Disease and Mortality.

These summaries comprise the results of the collection of such statistics as are furnished to the Board by the local authorities of cities and towns, either voluntarily or by statute requirements. They consist of four different series or sets of tabular material, as follows: —

1. The weekly mortality returns, or the summary of the voluntary returns of deaths in those cities and towns whose registration officials return these data to the State Board.
2. Summary of cases of infectious diseases reported to local boards of health, selected and compiled from the annual reports of such boards.
3. Summary of cases of infectious diseases reported by local boards to the State Board — chiefly diphtheria, scarlet-fever, measles and typhoid fever — under statutory requirement.
4. Annual returns of deaths in each city and town having over 5,000 population, also by statutory requirement.

As a matter of convenience these summaries have been grouped together, and are presented on pages 711–750 of this report.

Notification of Infectious Diseases.

The plan of requiring notice to be given of the occurrence of infectious diseases was established nearly a century ago by statutes making such notices compulsory, both on the part of the householder and of the attending physician. But little care was taken to secure the enforcement of such laws until within the past twenty-five years, when these laws were made more efficient by the requirement of penalties for neglect to comply with them and the introduction of other features providing for the systematic recording of data by local boards of health, and still later, by the statute requiring a further report by the local board to the State Board of Health. Similar statutes have been in force in England for several years, and the information thus furnished has frequently proved of great value in tracing the cause of epidemics and of devising and providing means for their prevention.

A summary of the reports received from the different municipal authorities required to report to the State Board of Health may be found in that portion of the report entitled Statistical Summaries of Disease and Mortality.

Food and Drug Inspection.

The importance of an abundant and wholesome food supply, in the preservation of the health and strength of a population, cannot be over-estimated.

The operations of the Board under the provisions of the food and drug acts have in each year from 1883 to the present year been made the subject of a special report, in which are presented the essential particulars of the work accomplished during the year. This report upon food and drug inspection presents a tabular summary of the entire work from 1883 to 1895 inclusive, together with the report of prosecutions submitted to the Legislature, and the reports of the analysts for the year ending Sept. 30, 1895.

From this report it appears that 7,309 samples of food and drugs were examined during the year, at a total cost for inspection, collection, analysis and prosecution of $11,375.89.

The number of prosecutions conducted in the same year was 92, and the number of convictions was 86, or 93.5 per cent.

Bacteriological Work and Organization of Department.

Hitherto, the principal department of bacteriological investigation conducted by the Board has chiefly been the examination of drinking water supplies with reference to their possible contamination with the germs of typhoid fever and kindred diseases, but the rapid advances which have been made in recent years in the investigation of the natural history of other infectious diseases, and the methods of their prevention and the consequent lessening of mortality from these causes, have led to the extension of this work into other fields.

In the last report of the Board (page cvii) reference was made to the work which had been initiated by the Board for the production of antitoxin and its distribution to boards of health throughout the State. For this purpose the services of Dr. J. L. Goodale were secured. He entered upon his duties with enthusiasm and successfully carried out the plans which the Board had designed with this end in view. To his energy much is due for the successful initiation of this new and important line of work. Since, however, it appeared desirable to enlarge the scope of this department, it was deemed best to obtain the services of an expert, who could devote his whole time

to bacteriological work and at the same time conduct investigations in such new fields of inquiry as might be presented.

For this purpose the Board appointed Dr. Theobald Smith of Washington, D.C., formerly Chief of the Division of Pathology of the Bureau of Animal Industry of the Department of Agriculture. A laboratory was established in the building known as the Bussey Institution, near the Forest Hills station of the New York, New Haven & Hartford Railroad, where facilities were also offered for stabling and caring for the horses required for antitoxin production.

More recently the work of examination of cultures in suspected cases of diphtheria was entered upon, and still later the examination of sputa suspected of containing the bacilli of tuberculosis. The appearance of malarial fevers in regions hitherto uninvaded has also suggested the examination of the blood of malarial patients, and with this end in view circulars have been issued to local boards of health offering the services of this department in making the necessary diagnostic examinations.

A report upon the production of antitoxin may be found among the special papers in this volume, and in the next annual report further information will be given in relation to the other branches of bacteriological investigation.

Lead Poisoning by Means of the Use of Lead Pipe for the Conveyance of Drinking Water.

In a State in which one hundred and fifty municipalities are supplied with water from nearly as many distinct and separate sources, the quality of the water furnished to consumers presents very many points of difference, as is specially shown by the reports of the Board upon the examination of water, issued during the past seven years.

In the present report (page 30) reference is made to the present water supply of one town (Kingston), where a considerable number of cases of lead poisoning occurred during the past year.

The water furnished to consumers in this town appears to have acted with unusual power upon lead pipes, especially upon those which were comparatively new. It was also found on investigation that lead pipe was used in Kingston to an unusual degree for house connections with the street pipes, and long lines of such service pipes, several hundred feet in length, were employed in not a few instances.

These facts, together with a careless use of water which had been allowed to stand in the pipes over night, undoubtedly accounted for the cases of illness, some of which were severe.

An investigation is now being conducted by the Board with reference to the question of lead poisoning by drinking water supplies in general, and will be reported upon in a future report.

The State Board of Health Exhibit at the Cotton States and International Exposition at Atlanta, Georgia.

The following invitation was received in August, 1895, from the Secretary of the Board of Managers representing Massachusetts at the Atlanta Exposition: —

Boston, Mass., Aug. 21, 1895.

To the Secretary, Massachusetts Board of Health, State House, Boston.

Dear Sir: — It is the desire of this Board that your department make an exhibit at the Cotton States and International Exposition, Atlanta, Ga., to be located in the State building to be erected on the Exposition grounds. We understand that you are willing to make an exhibit of this kind.

If convenient, as a matter of record, we should like to know what exhibits you intend to or can make conveniently. I suppose it will be scarcely possible for you to give this statement in much detail at this time. Can you make an approximate estimate of the probable cost of such an exhibit to the State, including of course, the getting of it to Atlanta, putting it up, and properly returning it into your possession?

Very truly yours,

Henry G. Kittredge,
Secretary.

The Board accepted the invitation thus tendered to them and placed the work of preparing the exhibit in charge of Prof. Wm. T. Sedgwick, who had successfully managed the Board's exhibit of 1893 at the Columbian Exhibition at Chicago.

Ample room was furnished for the exhibit in the second story of the Massachusetts building at the Atlanta Exposition.

The material of this exhibit was essentially the same as that which was presented at the Exposition at Chicago in 1893, and was detailed in the twenty-fifth annual report of the Board (page xviii), with such additions as represented the progress made by the Board by its sanitary work during the two years which had elapsed since the World's Fair. These were chiefly the maps, plans and report

showing the Metropolitan water supply, plans of the filter for purifying the city water supply of Lawrence, photographs of the antitoxin laboratory at Forest Hills, and plans of the more recent systems of sewage disposal adopted by cities and towns since 1893.

The directors of the Exposition, acting upon the suggestion of the jury of award, awarded the grand prize, or gold medal, to the State Board of Health "for a comprehensive exhibit of the means and methods adopted by the Board to promote the health of the people of the State and the country."

Manual of Health Laws.

The Board has published, at intervals of three or four years since 1882, a digest of the laws relating to public health in force in this Commonwealth, each revision containing all of the new health statutes and amendments up to the date of publication, together with such decisions of the supreme court as have been made upon cases which have been referred to it under these statutes. This manual has proved a very useful aid to the work of local boards of health, as well as to all persons connected with or interested in sanitary work.

Water Supply and Sewerage.

The engineering department of the Board was established in 1886, by authority of the new power conferred upon the Board by the enactment of chapter 274 of the Acts of that year. F. P. Stearns, C.E., was appointed as engineer of the Board in September, 1886, and continued as its engineer till August, 1895, when he was appointed engineer of the Metropolitan Water Board, and X. H. Goodnough was appointed engineer of the State Board of Health.

It is difficult to estimate the extent of the useful results accomplished under the provisions of this act during the ten years since it became a law of the Commonwealth.

An experiment station has been established for the purpose of investigating the important subjects of filtration of water and of sewage; thousands of samples of water, of sewage, of sands, gravels and other soils have been examined; rivers, brooks, ponds, lakes and springs have been visited and investigated in reply to applications for advice with reference to their usefulness for the purposes of water supply or to the prevention of their pollution; hearings and conferences

with city and town authorities have been frequently held, and advice has been given under the statutes to municipal authorities, corporations, firms and individuals in at least four hundred instances, and in cases in which the value involved has ranged from that represented by some comparatively small seashore water supply to those of the large cities involving several millions of dollars.

In this department have been planned several of the most important and extensive schemes relative to the water supply and sewerage of large communities.

These were the North Metropolitan sewerage system, providing for the sewage disposal of eighteen municipalities, most of which are north of the Charles River. This plan was reported to the Legislature in 1889, and was then ordered to be constructed and is now in operation. The cost of the works has been about $5,500,000.

The planning of the Metropolitan water supply was entrusted to the Board and was reported upon in 1895, and is now in course of construction.

This extensive work will provide a water supply for twenty-eight municipalities, containing at present about one million inhabitants, at an estimated cost of $27,000,000.

Other duties entrusted to the Board of a similar nature were the improvement of the Concord and Sudbury rivers, the improvement of the Neponset River, the reporting of a system of sewerage and sewage disposal for Salem and Peabody, and, in connection with the Metropolitan Park Commission, the improvement of the lower portions of the Charles River, and later still, as a joint Board with the Harbor and Land Commission, an investigation of the Green Harbor dike and marshes.

The work of the Board in this department for the year 1895 is presented in this report. It includes the following topics: Advice to cities and towns, details of the examination of water supplies and of rivers, summary of water supply statistics and records of rainfall, the hardness of water and methods by which it is determined, experiments upon the purification of sewage and water at the Lawrence Experiment Station, methods of determining the numbers of bacteria in sewage and water, and an account of the sewage disposal works now in operation in the State.

The Sanitary Condition of the Neponset Meadows.

During the session of the Legislature of 1895 a hearing was held by the legislative committee on public health with reference to the condition of the Neponset meadows and their effect upon the public health. These meadows occupy a large extent of territory upon both banks of the Neponset River from Walpole through the towns of Norwood, Canton, Hyde Park and Milton, nearly to the sea.

As a result of this hearing the Legislature enacted the following resolve: —

[Chapter 83 of the Resolves of 1895.]

Resolve directing the state board of health to investigate the sanitary condition of the Neponset meadows.

Resolved, That the state board of health be directed to investigate the sanitary condition of the meadows of the Neponset river and the beds, shores and waters of said river in the towns of Canton, Sharon, Norwood, Dedham, Milton and Hyde Park, and report whether their condition is dangerous or injurious to the public health by reason of stagnant water or refuse from manufactories, or other causes. If said board shall find that the condition of the meadows or of the beds, shores or waters is dangerous or injurious to the public health, they shall recommend some plan for improving their sanitary condition and for the removal of any nuisance therefrom, and report the same to the next general court. The board may expend a sum not exceeding three thousand dollars in carrying out the provisions of this resolve. [*Approved May 9, 1895.*

Investigations with reference to the subject contemplated by this resolve were still in progress at the time of printing this report.

The Sewage Disposal and Drainage of Salem and Peabody.

The Legislature of 1895, after consideration of a petition from the mayor of Salem for a commission to report upon a system of sewerage and sewage disposal for Salem and Peabody, enacted the following resolve: —

[Chapter 112 of the Resolves of 1895.]

Resolve relative to sewage disposal and drainage in Salem and Peabody.

Resolved, That the state board of health is hereby authorized and directed to consider and report a general system of drainage and sewerage for the city of Salem and town of Peabody, or for such parts of said city and town

not all of which shall be wholly within either of said municipalities, as may, in the opinion of said board, be best drained by said system. It shall be the duty of said board : — First. To designate the portions of said city and town which shall be tributary to and embraced in the district and system to be so reported, and to define the same by their report, with plans and maps. Second. To define and show, by suitable plans and maps, such trunk line and main branches as it shall recommend to be constructed, with outlet. Third. To consider the various methods of disposal of sewage and the application of such methods to any portion of the territory herein mentioned ; and to define the methods by which said city and town, or parts of said city and town, may utilize said trunk line and main branches as an outlet of a system of sewerage and drainage for said city and town and said parts of said city and town respectively ; and to show the same by plans and maps. Fourth. To employ such engineering and other assistance as may be necessary for carrying out the objects of this resolve, and to cause such surveys and levels to be made as will enable said board to determine with accuracy the location and grades of said trunk line and main branches, and also such surveys and levels in said city and town, and parts of said city and town, as will enable said board to determine with accuracy the methods by which said city and town, and parts of said city and town, may respectively utilize said trunk line and main branches, and to report such methods by plans showing the main lines by which each may so provide for itself a system of sewerage and drainage with its outlet into said trunk line or main branches. Fifth. To define the size and capacity of said trunk line and main branches, and the materials of which they should be constructed and manner of construction, and such other particulars as will enable said board to determine the probable expense thereof ; and to ascertain and report the cost of the construction of said trunk line and main branches and outlet, and to report a recommendation as to the methods of apportioning said cost. All expenses incurred by said board under the provisions of this resolve shall be reported to the governor and council, and all such expenses when approved by them shall be paid out of the treasury of the Commonwealth ; but the total expenditure shall not exceed three thousand dollars. The Commonwealth shall be reimbursed for such expenditure under this resolve as shall have been approved by the governor and council in the following manner : — The town of Peabody and the city of Salem shall each pay such proportion of the above expenditure as the said board shall deem to be equitable, and the amounts so to be paid by each shall be assessed and collected by the treasurer of the Commonwealth at the time required for the payment of the state tax of said town and said city respectively. Said board shall make all reports required by this resolve to the general court on or before the first Wednesday of January in the year eighteen hundred and ninety-six. [*Approved May 29, 1895.*

The State Board of Health began the work required by the foregoing resolve in June, 1895, but the time within which the report was to have been submitted to the Legislature being insufficient for the work in hand, the succeeding Legislature extended the time to July 1, 1896.

Health of Towns.

A digest of the principal facts of importance published in the annual reports of local boards of health occupies the final pages of this report. The table containing the number of cases and deaths from certain infectious diseases with the ratio of fatality has been transferred from this portion of the report to that part which is entitled "Statistical Summaries of Disease and Mortality."

Routine Work of the Board.

During the year ending Sept. 30, 1895, the Board held meetings at least once in each month during the year. Meetings of such of the standing committees as were necessary for the transaction of business were also held from time to time, as well as joint sessions with such other boards or commissions as were prescribed by the Legislature.

The office of the Board has been open throughout the year, as prescribed by the Public Statutes, chapter 21, section 10,* for the transaction of its authorized business.

Advice has been very frequently given at the office and by mail to local boards and to individuals in regard to sanitary matters, and many visits have been made by the secretary, the engineers and other experts to cities and towns for the purpose of making investigations and giving advice.

The work of the office has become materially increased during the year, in consequence of being made a central office for the distribution of antitoxin to local boards of health, hospitals and physicians in private practice.

The statistics of mortality compiled from the weekly postal card returns from the registering authorities of cities and towns have been published weekly during the year in the form of a bulletin, which also contains, once in each month, a report of the work done in the line of food and drug inspection, together with the prosecutions

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* Office hours, 9 A.M. to 5 P.M ; Saturdays, 9 A.M. to 2 P.M.

made under the food and drug acts, and other important information relative to the work of this department. In addition to these items there is also published in the same bulletin a weekly report of the number of cases of infectious diseases reported by the local boards to the State Board of Health.

The following table presents certain statistical data relative to the routine work of the Board: —

STATISTICAL TABLE FOR THE YEAR ENDING SEPT. 30, 1895.

Whole number of samples of foods and drugs examined during the year,		7,309
Samples of milk examined (included in the foregoing),		3,794
Whole number examined since beginning of work in 1883,		67,756
Whole number of samples of milk examined since beginning of work in 1883,		34,421
Number of prosecutions against offenders during the year,		92
Number of convictions during the year,		86
Amount of fines secured during the year,		$2,625 00
Force employed in general work of Board at central office, State House: —		
Secretary,		1
Clerks,		2
Messenger,		1
Total,		4
Force employed at central office, State House, Boston, for food and drug inspection, chemists and assistants,	2	
At Amherst,	1	
		3
Inspectors,		3
Total,		6
Force employed at laboratory (Bussey Institute): —		
Pathologist,		1
Assistants,		3
		4

UNDER THE PROVISIONS OF CHAPTER 375, ACTS OF 1888.

Applications for advice from cities, towns and others: —	
Relating to water supply,	38
Relating to sewerage and drainage,	9
Relating to pollution of streams,	5
Total,	52

Number of samples of water examined chemically and microscopically at the Massachusetts Institute of Technology,	2,250	
Number of samples of sewage and water examined chemically and bacterially at the Lawrence Experiment Station,	2,594	
Number of samples of sand examined chemically and bacterially at the Lawrence Experiment Station,	227	
Number of samples of sand examined mechanically at the Lawrence Experiment Station,	49	
Additional samples examined bacterially at the Lawrence Experiment Station.	6,073	
Total number of samples examined,	11,193	
Force employed at central office: *—		
Chief engineeer,	1	
Assistant engineers,	2	
Stenographers and clerks,	2	
	—	5
At Massachusetts Institute of Technology: —		
Chief chemist,†	1	
Assistant chemists,	5	
Chief biologist,†	1	
Assistant biologist,	1	
	—	8
At Lawrence Experiment Station: —		
Chemists,	2	
Bacteriologists,	3	
Other assistants and laborers,	5	
	—	10
Total ordinary force employed under chapter 375, Acts of 1888,		23
Total ordinary force in all departments,		37

The number of applications for advice under the provisions of chapter 275, Acts of 1888, received since July, 1886, when the act relating to water supply and sewerage first went into operation, is as follows: —

1886,	8	1892,	56
1887,	22	1893,	51
1888,	28	1894,	53
1889,	38	1895,	52
1890,	23		
1891,	53	Total,	384

* Not including the force employed upon the metropolitan water supply investigations, improvement of the Charles, Concord and Sudbury and Neponset rivers, or Salem and Peabody sewerage.

† The chief chemist and biologist, although located at the Massachusetts Institute of Technology, have the oversight of the chemical and biological work at the Lawrence Experiment Station.

Recommendations.

The following recommendation was made to the Legislature at the beginning of the session of 1896: —

The Board recommends the continuance of its investigations now being carried on as authorized by the provisions of chapter 375 of the Acts of 1888. For this purpose, and to make the necessary investigations in order to advise cities, towns, corporations and individuals in regard to the best methods of assuring the purity of intended or existing water supplies and the best method of disposing of sewage, and to carry out the other provisions of chapter 375 of the Acts of 1888, the Board estimates that the sum of $30,000 will be required.

Expenditures.

The work of the Board is conducted under the provisions of several statutes, and for its different departments of work these appropriations are annually made, one for the general work of the Board, one for the inspection of food and drugs and a third for carrying out the provisions of chapter 375 of the Acts of 1888, relating to the protection of the purity of inland waters. In addition to the foregoing, special appropriations have been made from time to time, as occasion has demanded, for the purpose of enabling the Board to conduct special lines of investigations.

The appropriations for the different departments of work in 1895 were as follows: —

For the general work of the Board,	$15,800
For food and drug inspection,	11,500
For carrying out the provisions of chapter 375, Acts of 1888,	30,000
Total,	$57,300

In addition to the foregoing regular lines of work the Board was also authorized to expend a sum not exceeding $3,000 for carrying out the provisions of a resolve directing the Board to "investigate the sanitary condition of the Neponset meadows,"* and a similar amount for the purpose of devising a system of "sewage disposal and drainage in Salem and Peabody."†

* Chapter 83 of the Resolves of 1895. † Chapter 112 of the Resolves of 1895.

The expenditures in 1895 under the foregoing appropriations were as follows: —

General Expenditures Sept. 30, 1894, to Sept. 30, 1895.

Salaries,	$4,820 00	
Travelling expenses,	841 99	
Stationery,	192 73	
Printing,	1,472 65	
Books, subscriptions and binding,	196 89	
Typewriting and library supplies,	18 18	
Telephone,	89 45	
Telegrams,	5 95	
Postage,	234 21	
Postal orders,	7 38	
Express,	178 97	
Advertising,	35 15	
Wrapping paper and twine,	27 39	
Copy press,	30 00	
Zinc plates, etc.,	35 92	
Extra services,	45 00	
Drafting diagrams,	22 00	
Services of messenger,	323 78	
Special investigations,	325 92	
Cooking utensils and enamelled ware for analysis,	17 19	
Ice collection for analysis,	2 40	
Chemical examinations,	9 00	
Recording temperatures of Charles River,	2 00	
J. W. Smith (weather reports),	75 00	
Sundry office supplies and incidental expenses,	297 25	
Inspection services,	30 00	
		$9,336 40

Expenditures at Bacteriological Laboratory.

Salaries,	$1,845 69	
Extra services, / Services,	22 00	
Labor (care horses, etc.),	197 10	
Travelling,	24 92	
Apparatus, chemicals and supplies,	2,244 02	
Purchase of horses and other animals,	199 85	
Board of horses,	596 32	
Express,	11 79	
Telephone,	30	
Postage,	71	
Stationery,	2 99	
Duties and charges on imported apparatus,	36 92	
Copy press,	27 65	
Mailing cases,	4 60	
		5,214 86
		$14,551 26

Expenses under Chapter 375 of Acts of 1888 (Protection of Purity of Inland Waters) for Calendar Year 1895.

Salaries, including wages of laborers at Lawrence Experiment Station,	$24,147 50
Apparatus and materials,	1,995 01
Rent of Rooms at Massachusetts Institute of Technology,	687 50
Rent of Lawrence Experiment Station (eleven months),	137 50
Travelling expenses,	1,285 51
Express charges,	708 54
Use of tools and office, Lawrence Experiment Station,	235 84
Books, stationery and drawing materials,	513 37
Maps, blue prints and photographs,	88 65
Paid for collecting samples,	17 30
Postage stamps,	72 08
Messengers, telegrams and telephone messages,	15 22
Printing,	95 96
Total,	$29,999 98

For Food and Drug Inspection for Year ending Sept. 30, 1895.

Salaries of analysts,	$4,500 01
Salaries of inspectors,	3,963 32
Travelling expenses and purchase of samples,	1,825 00
Apparatus and chemicals,	911 76
Printing,	4 00
Gas,	2 40
Expressage,	2 80
Legal services,	45 00
Sundry small supplies,	29 60
Extra services,	92 00
Total,	$11,375 89

H. P. WALCOTT,
H. F. MILLS,
F. W. DRAPER,
G. C. TOBEY,
J. W. HULL,
C. H. PORTER,
J. A. MEAD.

Improvement of the Concord and Sudbury Rivers.

IMPROVEMENT OF THE CONCORD AND SUDBURY RIVERS.

In the last annual report of the Board (page cviii) reference was made to the enactment of a statute of 1894 providing that the Board should conduct certain operations upon the Concord and Sudbury rivers for the purpose of improving the condition of the meadows along their banks.

After conducting this work as directed, the Board made the following report to the General Court in February, 1896, under the title of House Document No. 891: —

COMMONWEALTH OF MASSACHUSETTS.

BOSTON, Feb. 6, 1896.

The improvement of the Concord and Sudbury rivers has been carried on by the authority of chapter four hundred and twenty-six of the acts of eighteen hundred and ninety-four, section one, which is as follows: —

The State Board of Health is hereby authorized and directed to expend during the current year a sum not exceeding twenty thousand dollars, in dredging the bars in the Concord and Sudbury rivers above the dam at North Billerica and removing the weeds from said rivers, and in such other measures as shall, in the opinion of the board, tend to the restoration of the marshes along the said rivers to their original condition and to the abatement of malaria and other perils to the public health arising from the present state of the same. [*Approved May 24, 1894.*

It is also provided in the act that one-half the expense incurred shall be paid by the owners of lands benefited by the improvement, the other half being paid by the state.

The portion of the Concord and Sudbury rivers referred to extends from the dam across the Concord River at North Billerica for a distance of about twenty-five miles up-stream to a point in Wayland. Within this distance there was a large number of bars over which the water was only from two to four feet in depth in the summer season. At these shallow places there was usually a rank growth of weeds, greatly obstructing the flow of the stream.

The subject of the improvement of these meadows has been brought to the attention of the legislature from time to time for many years. Old reports refer to petitions to the legislature in sixteen hundred and thirty-six and again in sixteen hundred and forty-five, on account of the wetness of these meadows. Other petitions in seventeen hundred and forty-two, seventeen hundred and eighty-nine and eighteen hundred and sixteen are also referred to, and previous to eighteen hundred and sixteen and since that time there has been much litigation between the meadow owners and the owners of the dam at North Billerica and the city of Boston, which formerly let down water from compensating reservoirs in Hopkintown and Marlborough. During the years from eighteen hundred and fifty-nine to eighteen hundred and sixty-two the matter was before the legislature, and in eighteen hundred and sixty an act (chapter two hundred and eleven) was passed, appointing three commissioners with authority to lower the dam at North Billerica thirty-three inches. In eighteen hundred and sixty-one by chapter one hundred and fifty-four the act of eighteen hundred and sixty was suspended until the first day of May, eighteen hundred and sixty-two, and a commission was appointed to ascertain whether the dam at North Billerica caused the flooding of the meadows. The report of this commission and its extended surveys formed the basis for the act of the legislature in eighteen hundred and ninety-four. Some of its conclusions were as follows: —

"Fourth. Neither any change which can be made in the height of the dam, nor removing the dam altogether, will, alone, afford substantial relief to the meadows.

"Fifth. Keeping the river clear of weeds will, alone, in the ordinary state of the river, reduce the level of the water surface at the great meadows in Wayland and Sudbury six inches; but this will not afford substantial relief to the meadows.

"Sixth. Removing all obstacles to the flow of the water except the dam at North Billerica, and leaving the dam at its present height, will not substantially relieve the meadows.

"Eighth. The meadows can be effectually relieved only by reducing the height of the dam thirty-three inches or more; cutting out the Fordway and other bars, and deepening the shallow places in the river to such an extent that they shall cease to form any obstruction to the free passage of the water in the ordinary condition of the river; straightening the channel in a few places; and thereafter keeping the river free from weeds. In this way the meadows may be so relieved as to become fit for cultivation and valuable."

The expenses of this commission amounted to $18,730. Chapter one hundred and forty of the acts of eighteen hundred and sixty-two repealed the act of eighteen hundred and sixty for removing the dam.

Upon the passage of the act of eighteen hundred and ninety-four the board took the matter immediately under consideration and succeeded in finding the original plans made by the commission of eighteen hundred and sixty-one, also a profile showing the effect of various changes, such as the lowering of the dam, the removal of weeds and the excavation of the bars, in addition to the lowering of the dam. Note-books containing the original levels were also obtained.

The method of operating the water power at North Billerica during the time covered by the investigations was found to be for some reason entirely different from what it was in 1861, the water in the millpond under ordinary summer conditions now being drawn from twelve to eighteen inches below the top of the flashboards in the day time, but filling up and running freely over the flashboards again at nine or ten o'clock at night; whereas in 1861 the water was almost invariably above the top of the flashboards throughout the day except when the water was purposely maintained at a low level. On account of this change in the method of operation, the old report gives very little information as to the effect of lowering the water at the dam during the day by the ordinary operation of the mills upon the water in the long pool above the Fordway bar.

The diversion of water from the Sudbury River watershed by the city of Boston has caused a lowering of the water in the summer season along the river below the point of diversion, so that the conditions in this respect also are different from what they were in 1861. The conditions, on the whole, were found to be such that the board found it necessary to make an investigation to determine how great an improvement of the river could be made by the expenditure of $20,000 and whether the probable result to be obtained would warrant the expenditure proposed.

The investigations indicated that with a higher flow than often occurs during July and August it was not probable that the water at Farm Bridge in Wayland would stand more than two feet two inches above the level of the flashboards of the dam at North Billerica, unless water was being wasted from the dams of the Boston waterworks into the river below in addition to the small amount which the city of Boston is required to let run in the river. With the flow of water which makes the height of the water at Farm bridge two feet two inches above the level of the top of the flashboards the depth of the water flowing over the flashboards in the morning is about five inches; consequently, the height of the water at Farm bridge with this amount of water flowing was only one foot nine inches above the level of the water in the millpond just above the dam. As no stream will flow unless the water has a slope, it was obvious that the most extended improvement of the river which could be made without lowering the water at the dam would lower the water at Farm bridge less than one foot nine inches.

The first bars upon the stream above North Billerica begin about eighteen hundred feet from the dam, where there is a narrow rocky channel extending for a distance of five hundred feet up-stream. About four hundred feet above its upper end and about half a mile from the dam is the Fordway bar, which extends for a distance of seven hundred feet up-stream. About six hundred feet above the Fordway bar is Pollard's bar, which is about half as long as the Fordway bar and at a considerably lower level. The total fall over these bars in the morning when the water was flowing over the flashboards at the dam was found to be only about three inches, and any improvement which could be made at these bars with the sum which would be available would have been sufficient to lower the water only a very small amount at this place unless there was also a lowering of the dam.

In the course of the investigations it was learned that during the summer season the quantity of water which can be utilized in daytime at the dam is limited by the obstruction caused by the Fordway bar and the narrow rocky channel below it. Owing to these obstructions the mills cannot use in the daytime the full flow of the river during the twenty-four hours, for a portion of it runs to waste over the flashboards at night. If these obstructions should be partially or wholly removed, the mills could use a greater proportion of the total flow of the river and the water power would be benefited thereby. There was some question, therefore, whether in view of this benefit the mill owners might not be willing to lower their flashboards by an amount dependent upon the improvement of the channels, and in case such an arrangement had been made the river above the Fordway bar would have received the full benefit of the lowering of the flashboards and a slight additional lowering due to the greater capacity of the channel through the bar; but the bars in the vicinity were found to be composed of hard material which would have been expensive to move and would have limited the improvement in the rest of the river to such a degree that a satisfactory and permanent improvement of the channel above could not have been made with the amount of money available; and in view of all the circumstances the conclusion was reached that the money could best be spent in dredging the bars in the river farther up.

Several plans were considered, one of which provided for cutting a channel thirty feet wide on the bottom through the bars in Concord below the Assabet River, and twenty feet wide on the bottom through the bars above the Assabet, as far as the bar just above Farm bridge. The bottoms of these channels were to be five feet below the water level after the improvement had been completed; but it was not proposed to make any channel through a few bars where the depth was about four feet, as the depth of water over these bars was so great that they did not obstruct the flow of the water in more than a slight degree. A depth of five feet was decided upon to prevent the future obstruction of the channel by weeds.

The improvement proposed, it was estimated, would make no change in the level of the water below Barrett's bar in Concord. Above this point there would be a reduction in the height of the water of five inches at the junction of the Sudbury and Assabet rivers, nearly six inches from a point above the bars in Concord to a point just below Robbins' bar, seven inches just above Robbins' bar, and ten and one-half inches at Farm bridge. These amounts were estimated upon the basis of a fairly high summer flow such as is unusual in July and August, though it is exceeded in wet years.

The amount of lowering of the river that could be obtained was so small that before deciding to enter upon the work the Board consulted with the meadow owners, who were to pay half the cost, as to whether this amount of lowering of the surface of the river was sufficient in their opinion to warrant the expenditure. A meeting was held July 26, 1894, and the matter presented to the meadow owners by the Board. The meadow owners, after hearing the opinion of the Board as to the amount of improvement that could be accomplished by the proposed plan, held a meeting and subsequently informed the Board that it was their earnest desire that the plan be carried out as proposed. Upon the meadow owners expressing a desire that the work should be done as proposed, the Board at once prepared plans and advertised for proposals for the excavation of the proposed channels, and a contract was awarded August 30, 1894, for the excavation of the various bars at the rate of 33⅓ cents per cubic yard. The contractor, however, failing to furnish satisfactory sureties, bids were again asked for and the contract subsequently awarded to the Eastern Dredging Company, who were bidders at the time the contract was previously awarded and were now the lowest bidders, at 48 cents per cubic yard. The contract was made September 22, 1894, the contractors agreeing to complete the work by December 1, 1895. The time required for the preparation and transportation of machinery to Concord to begin the work was such that owing to the lateness of the season the beginning of the work was postponed until the spring of 1895, when the dredging in the stream was begun April 4. The work was prosecuted from this time until the twenty-first of December, and the dredging of all the bars up to the canal bridge in Wayland was completed. A list of the bars dredged, with the total number of cubic yards removed from each, is given in the following table:—

	Distances of Bars from the Dam at North Billerica (Feet).	Length of Bar (Feet).	Quantities in Cubic Yards.
1	From 47,550 to 47,950,	400	812.1
2	" 48,125 to 48,600,	475	1,343.3
3	" 51,450 to 51,950,	500	944.5
4	" 52,875 to 54,150, (Barrett's Bar).	1,275	4,152.7
5	" 58,100 to 58,350,	250	728.2
6	" 58,750 to 59,125,	375	1,083.5
7	" 59,400 to 60,375, (Assabet Bar).	975	4,571.9
8	" 60,900 to 62,900, (Concord Bar)	2,000	4,193.8
9	" 66,975 to 67,650,	675	1,293.6
10	" 68,650 to 69,100,	450	620.6
11	" 90,375 to 91,875, (Robbins' Bar).	1,500	3,132.2
12	" 93,150 to 93,350,	200	469.6
13	" 95,350 to 96,400,	1,050	1,718.4
14	" 104,600 to 107,200, (Sedge Meadow Bar).	2,600	3,469.8
15	" 108,400 to 109,200,	800	1,570.2
16	" 112,750 to 113,300, (Canal Bar).	550	1.229.2
	Totals,	14,075	31,333.6

The amount of excavation necessary was somewhat greater than was expected. The estimate of the amount of material to be removed was based upon a profile through the centre of the stream, as it was thought best under the circumstances to avoid the cost of a more careful survey. The width of the channel is thirty feet on the bottom below the Assabet River, twenty feet from the Assabet River to Sedge Meadow bar, and at that bar was reduced to sixteen feet to reduce the cost of the work as much as possible, the capacity of a channel of sixteen feet being as great in proportion to the amount of water to be carried as the twenty-foot channel is lower down.

The time for completing the work, as provided by the contract, expired December first and has not been extended, though a request for an extension has been made by the dredging company.

The following is a statement of the amount expended to the first of January, eighteen hundred and ninety-six, when the appropriation ceased to be available, and the amount of work done on the contract at that time which is as yet unpaid for. By the provisions of the contract approximate estimates have been made monthly by the engineer of the amount of earth dredged and disposed of, and a payment of eighty-five per centum of the amount of the contract price has been made thereon. The balance is to be paid upon the final completion, measurement and acceptance of the whole

work. No payment has been made for dredging done in the month of December after the date fixed in the contract for the termination of the work.

Appropriation,		$20,000 00
Salaries of engineers and assistants, including preliminary investigation and the inspection of the work,	$2,935 35	
Travelling expenses and subsistence of engineers,	330 83	
Paid Eastern Dredging Company,	11,791 20	
Labor,	195 86	
Observations of gauges,	59 05	
Expenses for boats	24 15	
Surveying instruments and repairs,	9 20	
Stationery and postage,	3 90	
Drawing materials,	6 33	
Maps and plans,	5 90	
Lumber,	43 65	
Tools, rope and other supplies,	20 13	
Expressage,	2 20	
Telephone and telegraph messages,	11 14	
Total,		15,438 89
Balance unexpended,		$4,561 11
Estimate of amount of work done after December 1,	$992 90	
Fifteen per cent held back from monthly estimates,	2,256 02	
		3,248 92
Balance to apply for dredging above Canal bridge,		$1,312 19

There are no other outstanding bills.

The material dredged has been disposed of generally by dumping it into the river at places where it is wide and deep; but material taken from the Concord bar and much of that from the Canal bar was deposited upon the surface of the meadows near the river.

There remain to be dredged between 3,000 and 4,000 yards in order to complete the work as planned, and I estimate that if the amount unexpended is reappropriated there will still be needed an additional appropriation of $1,000. The dredging of a portion of the Canal bar under the Canal bridge will have to be omitted unless the bridge is removed, because any movement of material under or near the bridge would be likely to cause it to collapse.

Respectfully submitted,

X. H. Goodnough,

Acting Chief Engineer.

THE

VITAL STATISTICS OF MASSACHUSETTS

For 1894.

The Vital Statistics of Massachusetts for 1894.

In the last report of the Board the subject of the vital statistics of the population was treated with greater fulness of detail than had been devoted to this subject in previous reports in consequence of the increasing demand for information of this character, as well as on account of the fact that vital statistics form the basis upon which a very large share of sanitary science is founded.

In the present summary a similar method of treating the subject will be employed with that which was followed in presenting the data for 1893, some of the longer tables being omitted.

Population.

Since the population forms the standard or basis of comparison in all statements of vital statistics a brief statement of the population will be presented in the following summary: —

The census of Massachusetts is taken every five years, that of 1870, 1880, 1890, etc., by the general government, and that of the intervening periods, 1885, 1895, etc., by the State.

The present summary of the vital statistics of 1894, although relating to a year previous to the taking of the State census, has the advantage of the census of 1895 as a basis of comparison, since greater accuracy is secured by estimating the population in a year intervening between two census years than in estimating that of a year following a census year, the population at a future census being unknown.

The population of Massachusetts in 1890 was 2,238,943, and that of 1895 was 2,500,183, the rate of increase (geometric) between the two census years having been a little over 2.23 per cent. annually.

Of the total population of 2,500,183 in 1895 1,214,701 were males and 1,285,482 were females.

The following table presents the summary of the census and estimated populations of the State from 1842 to 1895, together with the numbers of marriages, births and deaths in each year up to and including 1894.

The marriage, birth and death rates for the same years are also given, together with the excess of births over deaths in each year.

TABLE 1.—*Marriages, Births and Deaths in Massachusetts (1842-1894), with Population and Rates per 1,000 Living.*

Years.	Population.	Marriages.	Births.	Deaths.	Excess of Births over Deaths.	Persons Married to 1,000.	Births to 1,000 Persons.	Deaths to 1,000 Persons	Excess Rate of Births over Deaths.
*1841-42,	783,116	5,742	8,571	9,544	-	-	-	-	-
*1842 43,	806,862	5,807	8,750	10,684	-	-	-	-	-
*1843-44,	831,328	4,304	14,757	8,338	-	-	-	-	-
*1844 45,	856,536	4,863	15,711	8,844	-	-	-	-	-
*1845 46,	882,508	5,263	16,486	12,114	-	-	-	-	-
*1846 47,	909,267	5,390	17,097	14,492	-	-	-	-	-
*1847-48,	936,838	5,287	16,515	15,609	-	-	-	17.17	-
†1848,	-	4,015	12,540	12,475	-	-	-	19.58	5.16
‡1849,	965,245	6,936	25,773	20,423	5,350	-	26.70	21.16	5.54
1850,	994,514	10,345	27,664	16,606	11,058	20.80	27.82	16.70	11.12
1851,	1,020,673	11,966	28,661	18,934	9,727	23.44	28.08	18.55	9.53
1852,	1,047,520	11,578	29,802	18,482	11,320	22.10	28.45	17.64	10.81
1853,	1,075,072	12,828	30,920	20,301	10,619	23.86	28.76	18.88	9.88
1854,	1,103,350	13,683	31,997	21,414	10,583	24.80	29.00	19.41	9.59
1855,	1,132,369	12,329	32,845	20,798	12,047	21.77	29.01	18.37	10.64
1856,	1,151,461	12,265	34,445	20,734	13,711	21.30	29.91	18.00	11.91
1857,	1,170,864	11,739	35,320	21,280	14,040	20.05	30.16	18.17	11.99
1858,	1,190,584	10,527	34,491	20,776	13,715	17.68	28.97	17.45	11.52
1859,	1,210,657	11,475	35,442	29,976	14,466	18.96	29.28	17.33	11.95
1860,	1,231,067	12,404	36,051	23,068	12,983	20.15	29.28	18.74	10.54
1861,	1,238,177	10,972	35,445	24,085	11,360	17.72	28.63	19.45	9.17
1862,	1,245,328	11,014	32,275	22,974	9,301	17.69	25.92	18.45	7.47
1863,	1,252,521	10,873	30,314	27,751	2,563	17.36	24.20	22.15	2.05
1864,	1,259,756	12,513	30,449	28,753	1,696	19.87	24.17	22.83	1.35
1865,	1,267,031	13,051	30,249	26,152	4,097	20.60	23.87	20.64	3.23
1866,	1,302,992	14,428	34,085	23,637	10,448	22.14	26.16	18.14	8.02
1867,	1,339,976	14,451	35,062	22,773	12,289	21.57	26.17	17.00	9.17
1868,	1,378,010	13,856	36,193	25,603	10,590	20.12	26.26	18.58	7.68
1869,	1,417,125	14,826	36,141	26,054	10,087	20.92	25.50	18.39	7.12
1870,	1,457,351	14,721	38,259	27,329	10,930	20.20	26.25	18.75	7.50
1871,	1,494,334	15,746	39,791	27,943	11,848	21.08	26.63	18.70	7.93
1872,	1,532,258	16,142	43,235	35,019	8,216	21.08	28.22	22.85	5.37
1873,	1,571,146	16,437	44,481	33,912	10.569	20.92	28.31	21.58	6.73
1874,	1,611,022	15,564	45,631	31,887	13,744	19.32	28.32	19.79	8.53
1875,	1,651,912	13,663	43,996	34,978	9,018	16.54	26.63	21.17	5.46
1876,	1,677,351	12,749	42,149	33,186	8,963	15.20	25.13	19.78	5.34
1877,	1,703,182	12,758	41,850	31,342	10,508	14.98	24.57	18.40	6.17
1878,	1,729,410	12,893	41,238	31,303	9,935	14.91	23.84	18.10	5.74
1879,	1,756,042	13,802	40,295	31,801	8,494	15.72	22.94	18.11	4.83
1880,	1,783,085	15,538	44,217	35,292	8,925	17.42	24.80	19.79	5.01
1881,	1,813,818	16,768	45,220	36,458	8,762	18.49	24.93	20.10	4.83
1882,	1,845,081	17,684	45,670	36,785	8,885	19.17	24.75	19.93	4.82
1883,	1,876,883	18,194	47,285	37,748	9,537	19.38	25.19	20.11	5.08
1884,	1,909,233	17,333	48,615	36,990	11,625	18.16	25.46	19.38	6.08
1885,	1,942,141	17,052	48,790	38,094	10,696	17.56	25.12	19.61	5.51
1886,	1,998,174	18,018	50,788	37,244	13,544	18.04	25.41	18.64	6.77
1887,	2,055,823	19,533	53,174	40,763	12,411	19.00	25.87	19.85	6.04
1888,	2,115,136	19,739	54,893	42,097	12,796	18.66	25.95	19.90	6.05
1889,	2,176,159	20,397	57,075	41,777	15,298	18.74	26.23	19.20	7.03
1890,	2,238,943	20,838	57,777	43,528	14,249	18.62	25.81	19.44	6.37
1891,	2,288,911	21,675	63,004	45,185	17,819	18.94	27.53	19.74	7.79
1892,	2,339,993	22,507	65,824	48,762	17,062	19.24	28.13	20.84	7.29
1893,	2,392,216	22,814	67,192	49,084	18,108	19.07	28.09	20.52	7.57
1894,	2,445,604	20,619	66,936	46,791	20,145	16.86	27.37	19.14	8.24
1895,	2,500,183	-	-	-	-	-	-	-	-

* The statistics of the first eight years of registration are for the years ending with April 30 of each year.

† The second line of statistics for 1848 is for the eight months ending Dec. 31, 1848.

‡ The statistics for 1849 and for each of the following years are for the calendar years ending Dec. 31.

All estimates of inter-censal years in the table on the foregoing page are made in accordance with the rule recommended by Dr. Farr (the geometric rate of increase).

The vital statistics of the first seven years of registration (1842–48), together with the returns of marriages for 1849, must be regarded as extremely defective; many of the returns from Suffolk County for this period are wanting, together with those of some of the small towns. From the year 1849 onward the omissions probably constitute but a small percentage only of the total registration.

The figures for the population of census years are given in bold type.

Interstate and International Vital Statistics.

The following table presents briefly the marriage, birth and death rates of the New England States for a period of twenty years, or for so long a time as they were accessible.

The statistics of the principal European countries are also presented, the data from this portion of the table being mostly obtained from the report of the registrar general of England for 1894.

TABLE 2.—*Summary of the Vital Statistics of Principal Countries for Twenty Years, and for 1893 and 1894, together with those of the New England States.*

STATES AND COUNTRIES.	Twenty Years—1871-1890.				1893.				1894.			
	Marriage Rate.	Birth Rate.	Death Rate.	Excess of Birth Rate over Death Rate.	Marriage Rate.	Birth Rate.	Death Rate.	Excess of Birth Rate over Death Rate.	Marriage Rate.	Birth Rate	Death Rate.	Excess of Birth Rate over Death Rate.
Massachusetts,	18.1	25.7	19.7	6.0	18.7	27.5	20.1	7.4	16.9	27.4	19.1	8.3
Maine,	-	-	-	-	17.5	21.0	16.8	4.2	-	-	-	-
New Hampshire,	18.6	18.0*	18.9	-	21.2	20.5*	19.9	-	-	-	-	-
Vermont,	15.6	20.2	15.1	5.1	17.7	20.5	16.1	4.4	17.0	20.5	15.6	4.9
Rhode Island,	18.7	23.7	18.0	5.7	19.0	25.8	20.0	5.8	17.1	25.1	18.7	6.4
Connecticut,	16.0	23.6	17.1	6.5	16.4	24.7	18.9	5.8	14.2	24.9	16.8	8.1
NEW ENGLAND,	-	-	-	-	18.5	25.3	19.4	5.9	16.4†	25.9†	18.4†	7.5†
England and Wales,	15.6	34.0	20.3	13.7	14.7	30.8	19.2	11.6	15.1	29.6	16.6	13.0
Scotland,	13.9	33.6	20.4	13.2	13.2	31.0	19.4	11.6	13.4	30.1	17.2	12.9
Ireland,	9.0	24.9	18.0	6.9	9.4	23.0	17.9	5.1	9.4	22.9	18.2	4.7
Italy,	15.6	37.3	28.6	8.7	14.7	36.6	25.3	11.3	15.0	35.7	25.1	10.6
Denmark,	15.2	31.7	19.0	12.7	14.1	30.6	18.9	11.7	13.9	30.2	17.5	12.7
Norway,	13.7	30.7	16.9	13.8	12.8	30.7	16.4	14.3	12.8	29.7	16.9	12.8
Sweden,	13.1	29.8	17.6	12.2	11.3	27.4	16.8	10.6	11.5	27.1	16.4	10.7
Austria,	16.3	38.6	30.6	8.0	15.9	37.9	27.1	10.8	-	-	-	-
Hungary,‡	19.1	44.0	33.7	10.3	18.6	42.5	31.1	11.4	-	-	-	-
Switzerland,	14.7	29.4	22.1	7.3	14.7	28.5	20.5	8.0	14.9	28.2	20.7	7.5
German Empire,§	16.4	38.1	26.0	12.1	15.8	36.7	24.6	12.1	15.9	35.8	22.3	13.5
Holland,	15.1	35.2	22.6	12.6	14.6	33.8	19.2	14.6	14.4	32.7	18.5	14.2
Belgium,	14.2	31.0	21.4	9.6	15.2	29.5	20.3	9.2	15.1	29.0	18.6	10.4
France,	15.4	24.6	22.8	1.8	15.1	22.9	22.8	0.1	-	-	-	-
Japan,‖	-	27.7	20.5	7.2	-	-	-	-	-	-	-	-

* Seven years. Registration of births said to be defective. † Except Maine and New Hampshire. ‡ Fifteen years. § Nineteen years. ‖ Ten years (1883-92).

Marriages.

The whole number of marriages registered in Massachusetts in 1894 was 20,619. This number was equivalent to a rate of 16.86 per 1,000 of the estimated population (persons married), or 8.43 marriages in each thousand. It was also equivalent to one marriage in each 119 persons.

The number of marriages was less by 2,195 than those of 1893.

The marriages and marriage rates for the ten years (1885–94) were as follows: —

Table 3. — *Marriages and Marriage Rates, 1885-94.*

Years.	Marriages.	Marriage Rates.
1885,	17,052	17.6
1886,	18,018	18.0
1887,	19,533	19.0
1888,	19,739	18.7
1889,	20,397	18.7
1890,	20,838	18.6
1891,	21,675	18.8
1892,	22,507	20.0
1893,	22,814	18.7
1894,	20,619	16.9
Total,	203,192	-
Mean,	-	18.5

The marriage rate was less than that of any year since 1879. That of the ten-year period (1885–94) was 18.5.

Marriages by Counties. — The number of marriages in each county during the four years, 1891, 1892, 1893 and 1894, together with the marriage rates for 1890, were as follows: —

TABLE 4. — *Marriages by Counties, 1891-94, and Marriage Rates, 1890.*

	1891.	1892.	1893.	1894.	Marriage Rates, 1890.
THE STATE,	21,675	22,507	22,814	20,619	18.62
Barnstable,	245	221	209	214	16.78
Berkshire,	605	625	613	562	15.12
Bristol,	1,850	2,045	2,089	1,825	20.22
Dukes,	33	38	39	27	18.54
Essex,	2,905	2,899	3,108	2,691	18.48
Franklin,	310	331	335	284	14.76
Hampden,	1,388	1,479	1,401	1,270	17.64
Hampshire,	448	438	410	414	16.26
Middlesex,	4,083	4,259	4,373	3,721	17.80
Nantucket,	16	28	21	16	11.00
Norfolk,	944	956	976	830	15.76
Plymouth,	798	804	840	717	17.32
Suffolk,	5,574	5,708	5,745	5,809	21.94
Worcester,	2,476	2,676	2,655	2,239	17.70

Age. — The average ages at marriage of all men and women married, and of men and women married for the first time, were as follows: —

TABLE 5. — *Average Ages at Marriage, 1891-94, expressed in Years and Fractions of a Year.*

	Average Age of All Bridegrooms.	Average Age of All Brides.	Average Age of Men Marrying for the First Time.	Average Age of Women. Marrying for the First time.
1891,	28.85	25.53	26.82	24.28
1892,	28.85	25.37	26.76	24.24
1893,	28.90	25.47	26.86	24.40
1894,	29.10	25.59	26.93	24.39

Three hundred and seventy-seven men and 3,199 women married when under twenty years of age, and 69 men and 8 women married when over seventy. Of the former class there were 23 women aged fifteen, 6 aged fourteen and 1 of thirteen years; all the men were over fifteen years of age.

The mean age of men at marriage in England in 1894 was 28.4 years and that of women was 26.1 years.

Seasons. — The marriages by calendar months were as follows for 1894: —

TABLE 6. — *Marriages by Months (1894).*

	Marriages.	Monthly Ratio compared with a Standard of 100.*		Marriages.	Monthly Ratio compared with a Standard of 100.*
January,	1,634	93.3	September,	2,005	118.3
February,	1,088	68.8	October,	2,377	135.8
March,	1,053	60.1	November,	2,376	140.2
April,	1,867	110.1	December,	1,544	88.1
May,	1,405	80.2			
June,	2,433	143.5	Total,	20,619	-
July,	1,437	82.1			
August,	1,400	79.9	Mean,	-	100.0

* In this column the inaccuracies due to the unequal lengths of the months are eliminated by finding the daily number of marriages in each month and comparing this number with a daily standard of 100 for the whole year.

The mean daily number of marriages for the year was 56.5.

The greatest daily number of marriages occurred in June, October and November, and the least in March, February and August.

The percentages of marriages in each quarter were as follows: first quarter 18.31 per cent., second quarter 27.67, third quarter 23.48, fourth quarter 30.54.

BIRTHS.

The whole number of living births registered in Massachusetts in 1894 was 66,936, which was larger than that of any previous year since the beginning of registration. The birth rate was 27.4 per 1,000 of the estimated living population, which was less than that of either 1891, 1892 or 1893, but greater than that of any previous year since 1874.

The births and birth rates for the ten years 1885–94 were as follows: —

TABLE 7. — *Births and Birth Rates, Ten Years, 1885–94.*

YEARS.	Births.	Birth Rates.	YEARS.	Births.	Birth Rates.
1885,	48,790	25.1	1892,	65,824	28.1
1886,	50,788	25.4	1893,	67,192	28.1
1887,	53,174	25.9	1894,	66,936	27.4
1888,	54,893	25.9			
1889,	57,075	26.2	Total,	585,453	-
1890,	57,777	25.8			
1891,	63,004	27.5	Mean,	-	26.6

Sex. — Of the whole number of living children born in 1894, 34,338 were males and 32,575 were females, indicating a ratio of 1,054 males to 1,000 females, that of the period of forty-two years (1853–94) having been 1,055 males to 1,000 females.

The following were the numbers by sexes for the four years 1891–94 and for the forty-two years 1853–94 : —

TABLE 8. — *Births by Sexes, 1853-94, 1891, 1892, 1893 and 1894.*

YEARS.	Males.	Females.	Males to 1,000 Females.
1853–94,	920,067	871,781	1,055
1891,	32,532	30,434	1,069
1892,	33,758	31,951	1,057
1893,	34,328	32,829	1,046
1894,	34,338	32,575	1,054

The ratio of male to female births in England for the fifty-seven years ending with 1894 was 1,042 males to 1,000 females.

Seasons. — The number of births in each month and the monthly ratio reduced to a standard of 100 was as follows : —

TABLE 9. — *Births by Months (1894).*

MONTHS.	Births.	Monthly Ratio reduced to a Standard of 100.	MONTHS.	Births.	Monthly Ratio reduced to a Standard of 100.
January,	5,500	96.7	October,	5,530	97.3
February,	4,978	96.9	November,	5,579	101.4
March,	5,681	99.9	December,	5,907	103.9
April,	5,529	100.5			
May,	5,472	96.2	Unknown,	3	-
June,	5,506	100.1			
July,	5,999	105.5	Total,	66,936	-
August,	5,794	101.9			
September,	5,458	99.2	Mean,	-	100.0

The mean daily number of births was 183.4, and from the foregoing table it appears that the highest daily number of births occurred in July and December, and the least in May and January.

The highest quarterly percentage of births registered was in the third quarter of the year, and the same may be said of the births in each year of the previous twenty-year period, except 1878, in which the greatest number was in the fourth quarter.

Births by Counties. — The numbers of living births in each county during the four years 1891, 1892, 1893 and 1894, together with the birth rates for 1890, were as follows: —

TABLE 10. — *Births by Counties, 1891-94, and Birth Rates, 1890.*

	1891.	1892.	1893.	1894.	Birth Rates, 1890.
THE STATE,	63,004	65,824	67,192	66,936	25.81
Barnstable,	530	546	516	536	16.38
Berkshire,	2,179	2,083	2,283	2,248	26.32
Bristol,	5,436	5,924	6,200	6,188	26.58
Dukes,	56	71	73	65	18.08
Essex,	7,804	7,784	8,392	8,177	23.68
Franklin,	813	898	908	912	19.68
Hampden,	4,611	4,708	4,864	4,589	30.47
Hampshire,	1,126	1,229	1,194	1,194	20.90
Middlesex,	12,347	12,879	13,197	13,246	25.85
Nantucket,	52	50	55	55	15.30
Norfolk,	2,947	2,956	3,132	3,105	22.78
Plymouth,	1,905	1,946	2,144	1,976	18.96
Suffolk,	15,227	16,542	15,538	16,408	28.98
Worcester,	7,971	8,208	8,696	8,237	26.07

Illegitimacy. — The number of illegitimate births registered in 1894 was 564. The statistics of the years 1891, 1892, 1893 and 1894, with the ratios per 1,000 of living births, are as follows: —

TABLE 11. — *Illegitimate Births.*

YEARS.		Ratio per 1,000 Births.	YEARS.		Ratio per 1,000 Births.
1891,	1,078	17.1	1893,	540	10.2*
1892,	990	15.0	1894,	564	10.9*

* The illegitimate birth rates of 1893 and 1894 are estimated for the whole State, except the city of Boston.

TABLE 12. — *Illegitimate Births by Counties (1891, 1892, 1893 and 1894).*

	THE STATE.	Barnstable.	Berkshire.	Bristol.	Dukes.	Essex.	Franklin.	Hampden.	Hampshire.	Middlesex.	Nantucket.	Norfolk.	Plymouth.	Suffolk.	Worcester.
1891,	1,078	11	21	50	–	79	5	44	7	121	1	22	14	654	49
1892,	990	8	27	65	3	81	10	62	12	171	3	21	13	445	69
1893,	540	10	26	59	1	94	10	46	8	149	2	23	11	14	87
1894,	564	6	33	53	1	100	7	52	22	168	2	25	15	14	66

In the foregoing table are presented the statistics of illegitimate births by counties for the four years ending with 1894. The special point worthy of note in this table is the apparently defective record of Suffolk County for the years 1893 and 1894.

Plural Births. — In 1894 there were registered 654 cases of plural births, being in the ratio of 9.8 per 1,000 births. The number of children born was 1,316, of which number 1,292 were twins and 24 were triplets. Of the whole number, 658 were males and 657 were females.

The statistics for the four years 1891, 1892, 1893 and 1894 were as follows: —

TABLE 13.

YEARS.	Cases of Twins.	Cases of Triplets.	Cases of Quadruplets.	Numbers of Living Births to one Case of Twins.	Number of Living Births to one Case of Triplets.
1891,	616	7	1	102	9,000
1892,	572	8	–	115	8,228
1893,	610	9	–	110	7,466
1894,	654	8	–	102	8,367
Total, 4 years,	2,452	32	1	–	–
Mean,	–	–	–	107	8,217
Total cases, 1875–94,	9,101	103	1	–	–
Mean,	–	–	–	113	9,961

There has been a notable increase in the number and ratio of cases of triplet births in the past seven years, from 1 in 27,446 in 1888 to 1 in 8,367 in 1894.

Still-births. — The total number of still-births registered in 1894 was 2,353, the number for the two preceding years being 2,222 in 1892 and 2,444 in 1893.

The following are the statistics relative to the sexes of the still-born for 1894 and for the period 1853 to 1894, forty-two years: —

	1894.	1853-94.
Total number of the still-born,	2,353	55,788
Males,	1,424	30,941
Females,	854	20,768
Not stated,	75	4,079
Ratio of males to 1,000 females, among those whose sex was known,	1,667	1,490

Deaths.

"Mortality statistics surpass all other vital statistics in importance, whether they are considered from a social, an actuarial or a sanitary standpoint." — Newsholme.

The number of deaths registered in 1894 was 46,791; this was less than those of either 1892 or 1893, but greater than those of previous years.

The death rate per 1,000 of the estimated living population was 19.14, that of the decade ending with 1894 having been 19.70.

The following are the deaths and death rates for the ten-year period 1885-94: —

Table 14.

Years.	Deaths.	Death Rates.	Years.	Deaths.	Death Rates.
1885,	38,094	19.6	1892,	48,762	20.8
1886,	37,244	18.6	1893,	49,084	20.5
1887,	40,763	19.8	1894,	46,791	19.1
1888,	42,097	19.9			
1889,	41,777	19.2	Total,	433,325	-
1890,	43,528	19.4	Mean,	-	19.70
1891,	45,185	19.7			

Deaths by Sexes. — The number of deaths of males recorded in 1894 was 23,788 and that of females was 23,003. Estimating the distribution of the sexes upon the same basis as in 1890, the death rates of the sexes were 20.02 per 1,000 for males and 18.29 for females.

Table 15. — *Mortality of the Sexes, Census Years and 1894.*

Years.	Deaths of Males.	Deaths of Females.	Death Rate of Males.	Death Rate of Females.	Deaths of Males to 1,000 Deaths of Females in Equal Numbers Living.
1860,	11,444	11,547	19.3	18.4	1,048
1865,	13,085	13,024	21.7	19.6	1,107
1870,	13,699	13,598	19.5	18.6	1,048
1875,	17,329	17,619	21.8	20.5	1,063
1880,	17,426	17,852	20.3	19.3	1,052
1885,	18,889	19,205	20.2	19.0	1,063
1890,	21,767	21,761	20.0	18.9	1,058
1894,	23,788	23,003	20.0*	18.3*	1,094*

* Estimated.

The disparity between the death rates of the sexes in Massachusetts was generally less than that of England, which was as 1,121 deaths of males to 1,000 deaths of females in equal numbers living for 1894, and as 1,103 to 1,000 for the whole period of registration (1838–94).

Deaths by Seasons. — In the following table are presented the statistics of deaths in Massachusetts by months and by sexes. For the purpose of presenting the seasonal mortality as fully and as clearly as possible, the method employed by Dr. Böckh of Berlin in his "Jahrbuch" has been followed. The exceedingly accurate and careful statistical methods adopted in Berlin give to the mortality statistics of that city a value which cannot be attained here under present American modes of collection of statistics. The figures in the following table may be taken as approximately correct, any errors that may exist being probably limited to the decimals only in columns 4, 5 and 6.

TABLE 16. — *Mortality by Months, Massachusetts (1894).*

MONTHS.	1 Males.	2 Females.	3 Totals.	4 Death Rate per 1,000. (Annual.)	5 Monthly Mortality Reduced to a Standard of 100.	6 Deaths per Day.
January,	2,333	2,198	4,531	21.9	114.0	146.1
February,	1,793	1,793	3,586	19.2	99.9	128.1
March,	1,903	1,949	3,852	18.7	97.0	124.3
April,	1,935	1,768	3,703	18.4	96.3	123.4
May,	1,831	1,745	3,576	17.2	90.0	115.4
June,	1,684	1,631	3,315	16.5	86.2	110.5
July,	2,450	2,338	4,788	22.9	120.5	154.5
August,	2,254	2,317	4,571	21.9	115.1	147.5
September,	2,136	2,008	4,144	20.5	107.7	138.1
October,	1,872	1,831	3,703	17.6	93.2	119.5
November,	1,729	1,650	3,379	16.6	87.8	112.6
December,	1,868	1,775	3,643	17.3	91.6	117.5
	23,788	23,003	46,791	19.1	100.0	128.2

In the foregoing table, in the figures presented in columns 4 and 5 the inaccuracies due to the unequal length of the months have been eliminated by comparing the daily number of deaths in each month with the mean daily number for the year. In estimating the mortality rates given in column 4, a quarterly estimate has been adopted, based upon the rate of growth from 1890 to 1895, after the manner adopted by the registrar general of England in his weekly reports. By this table it appears that the months in which

the greatest daily number of deaths occurred were July, August and January, and those which had the least were June, November and May.

The percentages of deaths in each quarter of the year were as follows: —

In the first quarter,	25.6
In the second quarter,	22.7
In the third quarter,	28.8
In the fourth quarter,	22.9
	100.0

Deaths by Counties. — The number of deaths in each county during the four years 1891, 1892, 1893 and 1894, together with the death rates for 1890, were as follows, still-births being in every instance excluded in this table: —

TABLE 17. — *Deaths by Counties, 1891, 1892, 1893 and 1894, and Death Rates, 1890.*

	1891.	1892.	1893.	1894.	Death Rates, 1890.
THE STATE,	45,185	48,762	49,084	46,791	19.4
Barnstable,	615	640	592	559	19.4
Berkshire,	1,436	1,560	1,505	1,391	18.2
Bristol,	4,109	4,367	4,608	4,416	20.3
Dukes,	109	99	115	108	25.4
Essex,	5,916	6,272	6,064	5,584	20.0
Franklin,	699	766	654	608	15.8
Hampden,	2,644	3,181	2,999	2,616	19.6
Hampshire,	969	1,051	1,037	910	18.5
Middlesex,	8,506	9,038	9,420	8,862	18.4
Nantucket,	80	120	88	97	24.5
Norfolk,	1,945	2,087	2,294	2,176	16.5
Plymouth,	1,580	1,759	1,751	1,677	16.9
Suffolk,	11,357	12,013	12,280	12,385	22.3
Worcester,	5,220	5,809	5,677	5,402	17.8

The deaths in each county were less than those of 1893, with the exception of Nantucket and Suffolk, in each of which there was an increase.

CAUSES OF DEATH.

The following table is reproduced in this report for the sake of uniformity and comparison with similar tables of earlier years. Its significance, however, becomes of less importance in proportion to the progress made in medical science and the classification of the causes of death.

TABLE 18.— *Causes of Death, by Classes, in Census Years and in 1891, 1892, 1893 and 1894. Ratio per 10,000 of the Population.*

YEARS.	I. Infectious Diseases.	II. Constitutional Diseases.	III. Local Diseases.	IV. Developmental Diseases.*	V. Deaths from Violence.
1865,	64.87	51.63	50.79	26.48	7.34
1870,	47.45	49.30	51.85	21.87	7.79
1875,	58.96	49.40	65.44	23.16	8.61
1880,	47.41	45.89	73.73	19.52	7.19
1885,	36.74	45.94	82.76	20.65	7.48
1890,	36.09	41.14	87.13	19.63	8.10
1891,	36.10	39.47	91.75	20.18	8.10
1892,	39.55	39.84	97.74	20.39	8.89
1893,	36.53	39.24	98.10	19.78	9.25
1894,	35.93	37.94	88.47	18.39	8.64
1890–94 (Mean, five years, 1890–94),	36.83	39.50	92.68	19.66	8.61

* Still-births excluded.

By this table it appears that very marked changes have taken place in the groups marked I., II. and III., the first two having notably decreased, while the third has quite as notably increased.

The following table presents the mortality from the ten most prominent causes of death in Massachusetts for the ten years 1885 to 1894, in the order of their prominence: —

TABLE 19. — *Mortality from Ten Prominent Causes. — 1885-1894.*

CAUSES OF DEATH.	Deaths, 1894.	1894.	1893.	1892.	1891.	1890.	1889.	1888.	1887.	1886.	1885.
Consumption,	5,463	1	1	1	1	1	1	1	1	1	1
Brain diseases,*	5,113	2	3	2	2	2	2	2	2	2	2
Pneumonia,	4,101	3	2	3	3	3	3	3	3	3	3
Heart diseases,	3,621	4	4	4	4	4	4	4	4	4	4
Cholera infantum,	2,676	5	5	5	5	6	5	5	5	5	6
Diphtheria and croup,	1,801	6	10	9	10	5	6	7	7	7	7
Kidney diseases,	1,788	7	8	8	8	9	9	9	10	8	9
Old age,	1,669	8	6	6	6	7	7	6	6	6	5
Bronchitis,	1,572	9	7	7	7	10	10	8	8	10	8
Cancer,	1,568	10	9	10	9	8	8	10	9	9	10

* Including deaths certified as from apoplexy, paralysis, insanity, inflammatory diseases of the brain, and its membranes, and other brain diseases.

From this table it appears that consumption has maintained its position at the head of the list for the whole decade, although very closely approached by pneumonia in 1893. Brain diseases held the second place from 1885 to 1892, but, for the year 1893, was displaced by pneumonia. Diphtheria and croup attained the seventh place for the first four years, and then rose to the fifth, but fell to the last place in 1891 and 1893, rising again to the sixth place in 1894. Heart diseases and cholera infantum maintained, respectively, the fourth and fifth places for nearly the whole period.

Statistics of Certain Causes and Groups of Causes of Death, Massachusetts, 1894.

In Table 20 are presented the principal statistics relative to the following causes of death: —

Small-pox.	Pneumonia.
Measles.	Whooping-cough.
Scarlet fever.	Cancer.
Diphtheria and croup.	Kidney diseases.
Typhoid fever.	Heart diseases.
Cholera infantum.	Brain diseases.
Consumption.	

The data presented are the following: —

Number of deaths from each of the foregoing causes in each year for twenty years (1875–94), ...	Table 20
Death rate from each of the same causes per 10,000 of the living population for each year, ...	Table 20
Percentage of the total mortality for each year, ...	Table 20
The totals and means for the twenty-year period, ...	Table 20

TABLE 20.—STATISTICS OF CERTAIN CAUSES OF DEATH, MASSACHUSETTS, 1875-94.

Deaths, and Ratios compared with Population and Mortality, from All Causes.

	Small-pox.			Measles.			Scarlet Fever.			Diphtheria and Croup.			Typhoid Fever.			Cholera Infantum.			Consumption.		
	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.
1875, ...	34	.2	.09	233	1.4	0.67	1,684	10.2	4.81	1,880	11.4	5.31	1,059	6.4	3.02	2,606	15.8	7.45	5,738	34.7	16.40
1876, ...	31	.2	.09	47	0.3	0.14	1,222	7.3	3.68	3,294	19.6	9.92	881	5.3	2.65	2,087	12.4	6.29	5,327	32.2	16.05
1877, ...	24	.14	.08	135	0.8	0.44	467	2.7	1.49	3,178	18.7	10.14	814	4.8	2.59	1,927	11.3	6.15	5,457	32.0	17.41
1878, ...	2	.01	.01	305	1.8	0.97	404	2.2	1.29	2,517	14.6	8.04	679	3.9	2.16	1,573	9.1	5.02	5,334	30.8	17.04
1879, ...	7	.04	.02	19	0.1	0.06	850	4.8	2.67	2,293	13.1	7.21	637	3.6	2.00	1,349	7.7	4.24	5,223	29.7	16.42
1880, ...	38	.21	.11	236	1.3	0.67	574	3.2	1.63	2,394	13.4	6.78	882	4.9	2.50	2,118	11.9	6.00	5,494	30.8	15.57
1881, ...	47	.25	.13	230	1.3	0.63	397	2.2	1.09	2,383	13.1	6.54	1,072	5.9	2.94	1,861	10.3	5.10	5,886	32.4	16.14
1882, ...	45	.24	.12	68	0.4	0.18	318	1.7	0.86	1,771	9.6	4.81	1,079	5.8	2.93	2,159	11.7	5.87	5,865	31.8	15.93
1883, ...	5	.03	.01	321	1.7	0.85	575	3.1	1.52	1,621	8.6	4.29	860	4.6	2.28	1,941	10.3	5.14	5,931	31.6	15.71
1884, ...	3	.01	.01	75	0.4	0.20	627	3.3	1.69	1,646	8.6	4.45	875	4.6	2.36	2,081	10.9	5.62	5,798	30.4	15.67
1885, ...	19	.10	.05	313	1.6	0.82	587	3.0	1.54	1,523	7.8	3.98	768	3.9	2.02	1,852	9.5	4.86	5,955	30.7	15.63
1886, ...	-	-	-	130	0.6	0.35	331	1.7	0.89	1,558	7.8	4.18	800	4.0	2.15	1,931	9.7	5.18	5,897	29.5	15.83
1887, ...	3	.01	.007	455	2.2	1.12	594	2.9	1.46	1,628	7.9	3.99	922	4.5	2.26	2,131	10.4	5.23	5,871	28.6	14.40
1888, ...	8	.04	.02	219	1.0	0.52	504	2.4	1.20	1,831	8.7	4.35	943	4.5	2.24	2,195	10.4	5.21	5,728	27.1	13.61
1889, ...	6	.03	.01	171	0.8	0.41	185	0.8	0.44	2,214	10.2	5.30	891	4.1	2.13	2,156	9.9	5.16	5,581	25.7	13.36
1890, ...	1	.004	.002	114	0.5	0.26	196	0.9	0.45	1,626	7.3	3.74	835	3.7	1.92	2,491	11.1	5.72	5,791	25.9	13.31
1891, ...	1	.004	.002	236	1.0	0.52	246	1.1	0.54	1,218	5.3	2.69	821	3.6	1.82	2,771	12.1	6.13	5,484	24.0	12.14
1892, ...	2	.01	.004	88	0.4	0.18	669	2.9	1.37	1,455	6.2	2.98	827	3.5	1.69	2,898	12.4	5.94	5,739	24.5	11.77
1893, ...	9	.04	.02	276	1.1	0.56	810	3.4	1.65	1,394	5.8	2.84	750	3.1	1.53	2,704	11.3	5.51	5,527	23.1	11.26
1894, ...	33	.13	.07	98	0.4	0.21	649	2.6	1.39	1,801	7.4	3.85	748	3.1	1.60	2,676	10.9	5.72	5,463	22.3	11.67
Totals and means,	318	.08	.04	3,769	0.9	0.48	11,889	3.0	1.53	39,225	9.9	5.03	17,143	4.3	2.20	43,507	10.9	5.58	113,089	28.5	14.51

TABLE 20. — STATISTICS OF CERTAIN CAUSES OF DEATH, MASSACHUSETTS, 1875-94 — Concluded.

Deaths, and Ratios compared with Population and Mortality, from All Causes — Concluded.

	PNEUMONIA.			WHOOPING-COUGH.			CANCER.			KIDNEY DISEASES.			HEART DISEASES.			BRAIN DISEASES.		
	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.	Deaths.	Death Rate per 10,000 Living.	Percentage of Total Mortality.
1875, ...	2,940	17.8	8.40	242	1.5	0.69	593	3.5	1.69	509	3.1	1.45	1,331	8.1	3.80	2,590	15.7	7.40
1876, ...	2,447	14.6	7.37	192	1.1	0.58	657	3.9	1.98	488	2.9	1.47	1,335	8.0	4.02	2,507	14.9	7.55
1877, ...	1,972	11.6	6.29	369	2.2	1.18	646	3.8	2.06	535	3.1	1.71	1,355	7.9	4.32	2,521	14.8	8.04
1878, ...	2,171	12.6	6.93	400	2.3	1.28	807	4.7	2.58	615	3.6	1.96	1,442	8.4	4.61	2,778	16.1	8.87
1879, ...	2,647	15.1	8.32	302	1.7	0.95	862	4.9	2.71	693	3.9	2.18	1,515	8.6	4.76	2,820	16.1	8.87
1880, ...	3,076	17.3	9.71	230	1.3	0.65	928	5.2	2.63	698	3.9	1.98	1,726	9.7	4.89	3,210	18.0	9.10
1881, ...	2,967	16.4	8.14	217	1.2	0.59	949	5.2	2.60	825	4.5	2.27	1,937	10.7	5.31	3,355	18.5	9.20
1882, ...	2,932	15.9	7.97	265	1.4	0.72	987	5.3	2.68	877	4.7	2.38	2,025	11.0	5.50	3,393	18.4	9.22
1883, ...	3,045	16.2	8.07	137	0.7	0.36	1,026	5.5	2.72	959	5.1	2.54	2,153	11.5	5.70	3,562	19.0	9.44
1884, ...	2,646	13.9	7.15	410	2.1	1.11	1,060	5.6	2.86	1,000	5.2	2.70	2,117	11.1	5.72	3,669	19.2	9.92
1885, ...	3,468	17.9	9.10	184	0.9	0.48	1,087	5.6	2.85	1,088	5.6	2.86	2,227	11.5	5.85	3,894	20.0	10.22
1886, ...	2,836	14.2	7.61	271	1.4	0.73	1,104	5.5	2.96	1,135	5.7	3.05	2,325	11.6	6.24	3,844	19.2	10.32
1887, ...	3,348	16.3	8.21	232	1.1	0.57	1,174	5.7	2.88	1,120	5.4	2.75	2,690	13.1	6.60	4,257	20.7	10.44
1888, ...	3,716	17.6	8.83	245	1.2	0.58	1,275	6.0	3.03	1,318	6.2	3.13	3,061	14.5	7.27	4,522	21.4	10.74
1889, ...	3,440	15.8	8.23	310	1.4	0.74	1,325	6.1	3.17	1,258	5.8	3.01	3,280	14.2	7.85	4,313	19.8	10.32
1890, ...	4,038	18.0	9.28	363	1.6	0.83	1,387	6.2	3.19	1,273	5.7	2.92	3,417	15.3	7.85	4,389	19.6	10.08
1891, ...	4,337	18.9	9.60	219	0.9	0.48	1,395	6.1	3.09	1,474	6.4	3.26	3,592	15.7	7.95	4,711	20.6	10.42
1892, ...	5,020	21.5	10.29	248	1.1	0.51	1,402	6.0	2.87	1,535	6.6	3.15	3,733	16.0	7.65	5,036	21.5	10.33
1893, ...	5,499	23.0	11.20	274	1.1	0.56	1,533	6.4	3.12	1,685	7.0	3.43	3,511	14.7	7.15	5,144	21.5	10.48
1894, ...	4,101	16.7	8.76	435	1.8	0.93	1,568	6.4	3.35	1,721	7.0	3.68	3,432	14.0	7.33	4,995	20.4	10.67
Totals and means,	66,646	16.8	8.55	5,545	1.4	0.71	21,765	5.5	2.79	20,806	5.2	2.79	48,204	12.1	6.19	75,510	19.0	9.69

Statistics of Certain Causes and Groups of Causes of Death for Twenty Years in Massachusetts (1875–94).

Table 20 presents the statistics of certain destructive infectious and other diseases for a period of twenty years (1875–94), embracing the number of deaths, the death rate per 10,000 of the living population and the percentage of the total mortality for each year.

Small-pox.—The total number of deaths from this cause in 1894 was 33, a number greater than that of any year since 1882. It represented a death rate from this cause of .13 per 10,000 living and a percentage of .07 of the mortality from all causes.

Measles.—The deaths from measles was 98, or 178 less than those of the previous year and also less than those of any previous year since 1884, except 1892, when it was 88. The ratio of the living population was .4 and the percentage of the total mortality .21.

Scarlet Fever.—The deaths from scarlet fever were 649, which was less than those of either 1892 or 1893, but greater than those of any other previous years since 1876. The death rate from this cause was 2.6 per 10.000 of the living population and the percentage of the total mortality was 1.39.

Diphtheria and Croup.—The deaths from diphtheria and croup were 1,801, which was considerably greater than that of either of the four years 1890–93. The death rate per 10,000 living was 7.4 and the percentage of the total mortality was 3.85, both of which were less than the mean ratios for the twenty-year period (1875–94.)

Typhoid Fever.—The deaths from typhoid fever were 748, or less than those of any previous year since 1879. The ratio of the living population was 3.1 per 10.000 and the percentage of the total deaths was 1.6. Each of these ratios was less than the mean of the twenty-year period.

Cholera Infantum.—The number of deaths from this cause was 2,676. The death rate per 10,000 of the living population was 10.9 and the percentage of the total mortality 5.7. Each of these ratios being nearly identical with the mean for the twenty-year period.

Consumption.—The number of deaths from consumption was 5,463, or less than that of any year of the twenty-year period since 1879. The death rate per 10,000 of the living population and the percentage of the total deaths were each considerably less than

the mean of the twenty-year period, and each of these ratios has gradually diminished during the period. (For fuller information relative to the mortality from this cause see last annual report.)

Pneumonia.—The deaths from this cause were 4,101. The ratio per 10,000 living was 16.7 and the percentage of the total deaths 8.76, these ratios differing but little from the mean ratios of the twenty-year period.

Whooping-cough.—The deaths from whooping-cough in 1894 were 435. In absolute numbers, this mortality was greater than that of any year of the twenty-year period, but relatively it was exceeded by the mortality from this cause in 1877, 1878 and 1884. The death rate per 10,000 living was 1.8 and the percentage of the total mortality was .93, the means of the twenty-year period being 1.8 and .93.

Cancer.—The deaths from cancer were 1,568, which number was greater than that of any previous year of the twenty-year period. The death rate per 10,000 of the population was 6.4 as compared with a mean of 5.5 for the twenty years, and the percentage of the total mortality was 3.35, as compared with a mean of 2.79. The increase in mortality from this cause was not so rapid during the last ten years as during the first half of the period.

Kidney Diseases.—The deaths from this group of causes were 1,721, which was greater than that of any year in the twenty-year period from the same causes. The death rate per 10,000 of the living population was 7.0, as compared with a mean of 5.2, and the percentage of the total mortality was 3.68, as compared with a mean of 3.68.

Heart Diseases.—The deaths from this group of causes were 3,432, which number was less, absolutely, than that of either of the three preceding years. The death rate per 10,000 living was 14.0, as compared with a mean of 12.1, and was also less than that of either of the preceding six years. The percentage of the total mortality was 7.33, as compared with a mean of 6.19.

Brain Diseases.—The deaths from this group of causes in 1894 (including those from apoplexy, paralysis, cephalitis, insanity, softening of the brain and other brain diseases) were 4,995, which was less than those of either of the three preceding years. The death rate per 10,000 living from these causes was 20.4, as compared with 19.0 for the twenty-year period, and the percentage of the total

mortality was 10.7, as compared with 9.7 for the twenty-year period.

Erysipelas. — The deaths from this cause were 157, as compared with 251 in 1893.

Puerperal Fever.—The deaths from puerperal fever were 49, as compared with 46 in 1893. The deaths from other incidents of childbirth were 216.

Malarial Fevers.—The deaths registered as from these causes were 73.

Syphilis. — The deaths registered as from syphilis were 64, of which 37, or more than half, occurred in Suffolk County.

There were no deaths from hydrophobia, glanders, anthrax or trichinosis.

Medical Examiner Returns.

Separate returns of all deaths investigated by medical examiners are required by law. These comprise deaths by homicide, suicide, accidents and many deaths of a sudden or suspicious character which are referred to the medical examiners for investigation.

Of this class of deaths the whole number investigated in 1894 was 2,159, of which number 1,649 were deaths of males, 505 were deaths of females and the sex of 5 was unknown. The ratio of deaths of this class among males and females has shown but little change in the past ten years.

The whole number investigated was less than those of either 1892 or 1893, which were, respectively, 2,209 and 2,221. The mean annual number of deaths of this class investigated in the five-year period 1885–89 was 1,503, while that of the succeeding five-year period (1890–94) was 2,040, indicating a relative increase from 7.3 deaths per 10,000 of the living population investigated in the first period to 8.7 deaths per 10,000 in the second period.

Homicide. — The deaths from homicide were 68, as compared with 72 and 76, respectively, in 1892 and 1893. Comparing the two five-year periods 1885–89 and 1890–94 there was a slight increase, from an annual mean of .24 per 10,000 of the population in the former period to .27 per 10,000 in the latter.

Suicide. — The deaths from suicide were 270, while those of 1892 and 1893 were, respectively, 273 and 290. Comparing the two five-year periods, there was an increase from .87 per 10,000 of the living population in the former to 1.04 per 10,000 in the latter.

Accident. — The deaths from accident investigated were 975, as compared with 974 and 976 in 1892 and 1893. The mean annual ratio of deaths from accident investigated had also increased from 3.47 per 10,000 in the former to 3.97 in the latter period.

Deaths from Natural and Unknown Causes. — The deaths of this class investigated were 846, as compared with 890 in 1892 and 879 in 1893, while the mean annual ratio had increased from 2.72 per 10,000 in the former to 3.43 in the latter five-year period.

Water Supply and Sewerage.

ADVICE TO CITIES AND TOWNS.

WATER SUPPLY AND SEWERAGE.*

[Report required by the provisions of chapter 375 of the Acts of 1888, entitled "An Act to protect the purity of inland waters, and to require consultation with the State Board of Health regarding the establishment of systems of water supply, drainage and sewerage."]

The following report contains a summary of the work of the State Board of Health during the year 1895, under the provisions of chapter 375 of the Acts of 1888, including the substance of the replies made by the Board to those cities, towns, corporations and individuals which have applied to the Board for its advice relative to systems of water supply, drainage and sewerage, under the requirements of this act, together with a brief statement of the work done at the experiment station at Lawrence and in connection with the examinations of water supplies and rivers.

During the year 1895 public water supplies were introduced in the towns of Barre, Longmeadow, Millbury, Monson and Rockport, and important additions to the sources of many existing works were made. At the end of the year 1895 all of the 31 cities in the Commonwealth and 123 towns out of a total of 322 were provided with a public water supply. The total population of the communities having a public water supply is 89.5 per cent. of the total population of the State. There are now but 4 towns which by the census of 1895 have a population exceeding 3,500 which are not provided with a public water supply. The names of these towns, with their respective populations, are as follows: —

Town of Barnstable,	Population, 4,055
of North Andover,	" 3,569
of Blackstone,	" 6,039
of Winchendon,	" 4,490

* The first pages of this report were contained in a report made to the Legislature Jan. 6, 1896 (Senate Document, No. 4). A portion of the report then made, relating to the work done at the Lawrence Experiment Station, is not reproduced, because a more complete account of the work done at this place will be found in a subsequent part of this volume.

The rapid growth in the number of water supplies in the State in twenty years is indicated by a comparison of the statistics for 1895 with similar ones for 1875. At the end of the latter year 15 cities out of a total of 19 and 35 towns out of a total of 323 were provided with public water supplies, and the communities supplied contained 48.3 per cent. of the total population of the State.

The tendency in recent years toward municipal control of water supplies is indicated by a comparison of the number and population of municipalities supplied by private companies at the end of 1895 with the number similarly supplied at the end of 1890. At the end of 1895 all of the cities and 77 of the 123 towns in the State having a public water supply owned their works, while 46 towns were supplied by private companies. The total population of places supplied by private companies was 212,579, or 9.5 per cent. of the total population supplied. At the end of 1890 five of the 28 cities in the State having public water supplies and 50 of the 109 towns were supplied by private companies. The total population supplied from private works in 1890 was 318,319 or 16 per cent. of the total population supplied. There has been an increase of 17 in the number of works since 1890.

The flow of streams, as indicated by that of the Sudbury River, was less than the normal in January, February, March, May, June, August and September, slightly in excess of the normal in April and July, and very greatly in excess in the months of October, November and December, the average flow for November being the highest recorded in that month on the Sudbury for twenty-one years. The result of this distribution of the flow upon sources of water supply was to cause many of the large ponds having comparatively small water-sheds to fail to fill in the spring; but, owing to the early and heavy rainfall in the fall, the drought was not felt so seriously as has been the case in other years. The very low flow of streams in September and the early portion of October was severely felt by those communities supplied from small reservoirs having comparatively large water-sheds, which depend largely upon the daily flow of the streams to prevent a shortage of water.

The chemical analyses of the water supplies and rivers of the State have been continued during the year, 2,250 samples having been examined. The following is a classified list of the waters examined during the year: —

TABLE I.

From open and covered reservoirs for the storage of ground waters,	46	
From ground-water supplies,	393	
Special investigations of regular water supplies affected by tastes, odors, etc.,	19	
From ponds and storage reservoirs and their inlets,	815	
From streams and miscellaneous sources,	100	
Total from regular water supplies,		1,373
In connection with investigations of new sources of water supply,	295	
With reference to pollution of streams,	287	
With reference to sewage purification at Worcester, Framingham, Marlborough, Gardner, Medfield, etc.,	246	
In connection with the study of epidemics,	7	
Miscellaneous,	42	
		877
Total,		2,250

The examination of the microscopic organisms has also been continued in the waters which have been examined chemically, and those which are found in large numbers in any water at times when there is complaint of its taste or odor have been studied with special attention, with a view to learning the conditions necessary to their existence and development.

With the rapid extension of water-supply systems throughout the State and the constant increase in the use of water has come not only a recognition of the necessity that the supply shall be ample in quantity at all times, and free from danger of contamination by animal refuse or other poisonous matter, but also an appreciation of the importance of excellence in other respects; and the possession by a community of a water that is at all times soft, free from taste or odor and of attractive appearance, has a certain commercial value as well, compared with less attractive supplies.

Of the supplies in the State drawn from natural ponds, some have from time to time been affected by the presence of microscopic organisms in such numbers as to cause the waters to become offensive to taste and smell to such a degree in some instances as to lead to the consideration of measures for obtaining a satisfactory supply from another source, at least during times when the water of the present source is unfit for use. The periodic occurrence of such conditions in ponds, which at other times may furnish a water of satisfactory

quality, indicates the necessity of thorough investigation of a source before the construction of works for supplying a community with its water is undertaken.

Investigations as to the quality of water of artificial storage reservoirs, both of those which have been thoroughly prepared for the purpose by the removal of all soil and vegetable matter from the area flowed, and of those where the preparation has been insufficient or where no preparation at all beyond a simple clearing of the area has been made, have shown that, while water often deteriorates greatly in quality when stored in reservoirs of the latter class, on the other hand, the quality of the water is not only unlikely to deteriorate, but is likely to improve by storage in reservoirs thoroughly prepared for the purpose, the degree of improvement depending chiefly on the character of the water as it enters the reservoir and the length of time that it is allowed to remain there.

The occurrence of excessive amounts of iron in ground waters has frequently been referred to in previous reports. Information obtained from systematic examinations of existing sources and from investigations of proposed new supplies has shown that the quality of the water taken from single test wells, from which comparatively little water has previously been drawn, frequently does not furnish a reliable indication as to the probable quality of the ground water of a locality after the comparatively large quantity used by a town or village has been drawn from the ground in the vicinity for a considerable length of time. A satisfactory knowledge on these points can often be obtained only from long-continued pumping from such sources under circumstances which would most readily allow of the development of unfavorable conditions affecting the quality of the water. Such pumping tests, when accompanied with careful observations, are usually valuable in the indications that they may furnish of the probable capacity of a ground-water source.

As a result of its investigations, the Board has frequently called attention to the danger in the use for domestic purposes of water taken directly from running streams exposed to pollution by inhabitants upon their water-sheds; and a marked decrease in the use of such sources has been noted, several communities going to the expense of entirely new sources of supply, to avoid the use of water from polluted streams.

Observations of the operation of the Lawrence city filter have been continued through the year, and a summary of the results of chemical

and bacterial analyses of samples of water before and after filtration is given in subsequent pages. The following table, which is the result of a careful investigation, shows the total number of deaths from typhoid fever in Lawrence and the deaths from this cause per 10,000 inhabitants for the year 1895 and the ten previous years: —

TABLE II.

Deaths from Typhoid Fever in Lawrence, 1885–95.

YEAR.	Total Number of Deaths.	Deaths per 10,000 of Population.	PERSONS KNOWN TO HAVE BEEN EXPOSED TO INFECTION BY —		
			Drinking Canal Water.	While living out of Town just before falling sick in Lawrence.	Nursing Other Patients.
1885,	17	4.2	-	-	-
1886,	23	5.75	-	-	-
1887,	47	11.75	-	-	-
1888,	48	12.	-	-	-
1889,	55	13.75	-	-	-
1890,	60	13.33	-	-	-
1891,	55	12.20	-	-	-
1892,	50	11.11	-	-	-
1893,	39	8.66	-	-	-
1894,	24	5.00	12	4	1
1895,	16	3.07	9	2	-

Certain facts are to be noted in connection with the figures presented in the table. Investigations by the Board of the causes of the excessive death rates from typhoid fever in Lawrence in the years 1889 and 1890 pointed so strongly to the water supply as one of the important causes that the Board at the beginning of 1891 warned the citizens against its use for drinking except after thorough boiling. Supplies of water pumped directly from the canals are used for certain purposes in the mills; this water is in many places easily accessible for drinking and is so used, notwithstanding that city water is also provided. The filter was first operated in September, 1893, and all of the water supplied to the city has been filtered since that time.

In connection with investigations as to the purification of sewage, a large number of samples of sewage and effluent from existing sewage disposal works has been examined. The results of these

investigations are of much value, when taken in connection with the information obtained at the Board's experiment station, in advising cities and towns with reference to the disposal of sewage.

The growth of manufacturing industries and the increase in the population of manufacturing towns and villages have tended to increase the pollution of streams, while the reduced flow of the streams in the past two dry seasons has assisted in making the effect of the pollution more noticeable. The condition of those streams most liable to serious pollution is examined from time to time by means of chemical analyses, and in some cases steps are being taken by local authorities for the removal of causes of pollution.

The subject of the treatment of manufacturing sewage has received much attention during the year, and experiments have been begun with reference to purifying refuse from tanneries, wool-washing and other establishments, drainage from which is a prime factor in the pollution of many streams and watercourses. While the experiments have not yet been carried far enough to warrant any extended statement as to the results obtained, it may be said that sufficient information has been furnished by the investigations thus far made to make it evident that manufacturing sewage may be purified sufficiently to prevent its polluting a stream, at a sufficiently moderate cost to obviate the danger of crippling the manufacturing industries.

ADVICE TO CITIES AND TOWNS.

Under the provisions of chapter 375 of the Acts of 1888, entitled "An Act to protect the purity of inland waters, and to require consultation with the State Board of Health regarding the establishment of systems of water supply, drainage and sewerage," the Board is required "from time to time *to consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply, drainage or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their drainage or sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby.* It shall also from time to time consult with and advise persons or corporations engaged or

intending to engage in any manufacturing or other business, drainage or sewage from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal or purification of such drainage or sewage: *provided*, that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. *All such authorities, corporations, firms and individuals are hereby required to give notice to said Board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and sewage; and all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said Board thereon.*"

During the year 1895 the Board has given its advice to the following cities, towns, corporations and individuals who have applied for such advice under the provisions of the general act of 1888, or under special acts relating to water supply and sewerage.

Replies were made during the year to applications made from the following sources for advice relative to water supply: Adams (two replies), Amesbury (the Powow Hill Water Company), Billerica, Bradford, Brookfield, Cohasset, Dighton and Somerset (two replies), the Edgartown Water Company, Gloucester, Greenfield, Groton, Hatfield, Haverhill, Holden, Holyoke, Kingston, Leicester, Leominster, Lowell, Montague (Miller's Falls), Montague (Village), Paxton, Pepperell, Pittsfield, Reading, Rutland, Sheffield, Shirley, Stoughton, Walpole, Wenham, Westfield, Weston, Williamstown, Winchendon, Wrentham (Plainville) and Worcester.

Replies relating to sewerage and sewage disposal were made, in answer to applications from the following sources: Amesbury, Andover, Brockton, Fairhaven, Framingham, Springfield, Tewksbury, the State Farm at Bridgewater, and Webster.

Replies were also made during the year relative to the subject of pollution of streams, to certain authorities and other parties in the following towns: to the board of health of Danvers, relative to the pollution of Crane's River; to the selectmen of Millbury, in reply to a communication relative to the pollution of the Blackstone River by the city of Worcester; to the selectmen of Shrewsbury, relative to the pollution of Lake Quinsigamond by the sewage of the State Lunatic Hospital at Worcester; and to the selectmen

of Northborough, in reply to a letter relative to the pollution of Lake Chauncy by the sewage of the State Lunatic Hospital at Westborough.

Water Supply.

The following is the substance of the action of the Board during the past year, in reply to applications for advice relating to water supply: —

Adams. The committee on water supply of the Adams Fire District applied to the Board Feb. 21, 1895, for its advice relative to taking a ground-water supply from the valley of the Hoosac River, and as to the best method of supplementing its water supply. The Board replied to this application as follows: —

Boston, May 2, 1895.

The portion of the valley indicated by you as a possible ground-water source is in the vicinity of the Hoosac River, south of Cheshire Harbor. This locality has been examined by one of the engineers of the Board, but, as no tests have been made by driving wells or otherwise to show the character of the material beneath the surface and to obtain a sample of water for analysis, it is impracticable to advise definitely at the present time as to the probable quality and quantity of water to be obtained at this place.

A sample of water collected April 17, 1895, from a flowing tubular well in the valley of the river at Zylonite, was analyzed, and found to be so hard that it would not be of satisfactory quality for many of the purposes for which a public water supply is used; and the same statement may be made with regard to the water supplied from the wells of the North Adams water works.

In view of these results, there is much doubt as to whether a water supply contained from the ground as proposed would be of satisfactory quality; and this point can be definitely settled only by determining the hardness and other characteristics of a sample of water taken from the ground at the proposed location.

While, as already stated, it is impracticable to advise definitely at this time as to the probable quantity of water, it may be said that the surface indications point to a limited rather than to an ample supply.

In view of the insufficiency of the present sources of supply during the dry portion of the past year, and the uncertainty as to the best method of obtaining a supplementary supply, the Board advises you to have the whole question of the water supply of the town more thoroughly investigated, with the aid of an engineer skilled in such work.

In addition to the investigation with regard to obtaining a supplementary ground-water supply, it is desirable to ascertain the quality and quantity of

water flowing during the dry portion of the year in streams not now used, but which may be available for supplying your town; and to ascertain whether it is not feasible to build a reservoir to store enough water to maintain the supply during the portions of the year when the natural flow of the streams is insufficient. It would also be well to have the quantity of water used by the town measured, with a view to determining whether the consumption of water is excessive; and, if this should be found to be the case, it might be feasible to materially reduce the consumption by preventing leakage and waste, and in this way make the consumption of water correspond more nearly with the capacity of the sources.

This Board will aid you in making such investigations by analyzing samples of water, and by furnishing to your engineer any information now in its possession bearing upon the question; and will, upon application, when you have further information to present, advise you further as to the most appropriate method of increasing your supply.

On Aug. 1, 1895, the water committee again applied to the Board for its advice, relative to taking an additional supply of water from the ground in the Hoosac valley above Cheshire harbor and below the village of Cheshire. The Board replied to this application as follows: —

BOSTON, Oct. 3, 1895.

The State Board of Health received from you on Aug. 1, 1895, an application asking for the advice and approval of the Board of a plan for obtaining an additional water supply for the Adams fire district from the ground in the valley of the Hoosac River above Cheshire harbor and below the village of Cheshire by means of tubular wells, the water to be pumped into the main pipe leading from Bassett Brook reservoir, one of the present sources of supply to the town.

Accompanying the application is a report by your engineer, containing the results of investigations made by him of various sources in the vicinity of the town, and the Board has also caused a further examination of these sources to be made by one of its engineers. As a result of these investigations, it is found that the flow of the brooks at present used for the supply of the town and of two other brooks in the vicinity on September 6 and 7, when there had been no rain for several days, was about as follows: —

Bassett Brook,	275,000 gallons per day.
Dry Brook,	90,000 gallons per day.
Tophet Brook,	127,000 gallons per day.
South Brook,	315,000 gallons per day.

Samples of water collected September 7 from your present sources of supply and from other sources examined have been analyzed, and a com-

parison between the results of these analyses and of the analyses of samples collected from these same sources in the earlier portion of the year may be made from the following table: —

SOURCE.	Hardness September 7.	Hardness in Earlier Portion of the Year.
Tophet Brook,	7.6	1.4
Dry Brook,	9.4	1.6
Bassett Brook,	3.2	1.1
South Brook,	3.2	1.6
Test well above Cheshire Harbor,	11.0	10.3* 10.6* 14.8*
Renfrew well,	12.6	12.3

* Three test wells.

The results of the analyses show that the hardness of the water of Tophet and Dry brooks was several times as great in September as in the earlier portion of the year, while the increase in the hardness of the water of South Brook was comparatively small. From the results of the examinations it appears that a supply of water somewhat greater than the amount yielded by Bassett Brook and of equally good quality with respect to hardness, would be furnished by South Brook. The quality of this water is also satisfactory in other respects.

It appears from the report of your engineer that a storage reservoir having a capacity of about 43,000,000 gallons can be constructed upon this brook and that the water of this reservoir could be supplied to the town by gravity by laying a pipe to connect with the pipe leading from your present Bassett Brook reservoir. The estimates of cost indicate that the first cost of a supply from this source would be about two and one-half times as great as that from tubular wells in the valley of the Hoosac River above Cheshire Harbor; but the annual cost of maintenance, including interest, would not be proportionally greater, because the water of South Brook would be delivered to the town by gravity, and the cost of pumping would be avoided.

By taking a supply from South Brook the town would obtain a soft water of excellent quality for the purposes of a public water supply. The water of the test wells, on the other hand, though of excellent appearance and practically free from organic matter, is so hard, owing to the presence of lime in solution, that it would be undesirable for drinking and objectionable for many other purposes of a domestic water supply.

The Board regards it of importance to the health of the town to avoid the very hard waters, and obtain as soft water as practicable. The water of South Brook is the most satisfactory in this respect, and the Board is informed that by the construction of a reservoir in the upper part of Dry Brook a softer water may be obtained in a dry time than is now obtained from this brook.

By the provisions of the act passed last spring, no authority is given the town of Adams to take any source in Cheshire south of the southerly boundary of the former town of New Providence, which excludes South Brook. In view, however, of the excellent quality of water obtainable from this source, the Board would advise that you take measures to secure the right to take the water of this brook, subject to the right of the town of Cheshire to such an amount of water from this source as may be needed for the supply of the town in addition to the waters of Thunder and Kitchen brooks when they shall have been fully developed.

The population of Cheshire has steadily decreased for the past fifteen years, and, moreover, the sources in the region from which its present supply is taken have not been fully developed, so that there is no present indication that any water need be drawn from South Brook for the supply of Cheshire.

The yield of South Brook, with a storage reservoir having a storage capacity of 43,000,000 gallons, would, in connection with your present sources, amount to about 1,100,000 gallons per day in the drier months of a very dry season.

Measurements made by your engineer in the early part of July indicate that at that time the consumption of water in the town amounted to 1,150,000 gallons per day, equivalent to 147 gallons per person per day. This is an excessive consumption and is greater than that of any other city or town in the State where records of the consumption of water are kept. There appears to be no good reason why the consumption should be larger than that of other towns where the conditions are similar, and by reducing it to a reasonable amount the capacity of your present works, with the addition of a storage reservoir on South Brook, will be sufficient for the town until a large increase over the present population takes place.

AMESBURY. The Powow Hill Water Company applied to the State Board of Health March 18, 1895, for its advice relative to taking an additional supply of water from the ground near Main Street in that town. The Board replied as follows: —

BOSTON, June 6, 1895.

The Board has caused examinations of the present and proposed sources of supply and analyses of water from each of the sources to be made. From

the information thus obtained the Board finds that the present sources are likely to be inadequate in a dry year for supplying the present consumers with water.

The analyses of samples of water taken from the test well at the proposed source show that the water is at present of excellent quality, and, although it may change somewhat in character with a continuous draught upon this source, it will probably remain of suitable quality for water-supply purposes, unless there should be a considerable increase in the population in the vicinity of the well.

The conditions, however, do not appear favorable for obtaining any large additional supply of water from this source, and, as it is the general experience of cities and towns that the amount of water consumed increases much faster than the population, both on account of the increasing proportion of the inhabitants supplied with water and the increasing use of water per consumer, it is not probable that the proposed additional supply would meet the requirements for more than a very few years.

The Board, therefore, believes it to be desirable, in order to provide adequately for the present and future needs of the town, and probably in the interest of true economy, to obtain a larger additional supply of pure water than can be obtained from the proposed source near Main Street, and advises that you make further investigations, with the aid of a competent engineer, to ascertain whether it is not feasible to obtain such a supply.

Billerica. J. Nelson Parker and other petitioners applied to the Board March 6, 1895, for its advice relative to the use of the water of Nutting's Pond in Billerica for fire and domestic purposes for that town. The Board replied to this application as follows: —

Boston, April 4, 1895.

The State Board of Health has considered your application relative to a proposed water supply to be taken from Nutting's Pond in Billerica, has had the pond examined by one of its engineers, and has caused a chemical and microscopical examination of a sample of water collected from it to be made.

The chemical examination shows that the water has a high color and contains a large amount of organic matter, much of which is in suspension; and the microscopical examination shows that a large part of the suspended organic matter is a minute organism, of a kind which is known to have caused bad tastes and odors in other water supplies of the State. The water, therefore, although not polluted by sewage, and no worse in other respects than that furnished to a few places in the State, cannot in its present condition be regarded as of satisfactory quality for the purposes of a public water supply.

The Board therefore advises the investigation of other available sources, to ascertain if a better one cannot be found; and it may also be well to determine whether the pond can be improved as a source of water supply by any changes which it is feasible to make in or near it, and to have samples of water collected from the pond at other seasons of the year and analyzed.

BRADFORD. An application was received from the Bradford Water Company for the advice of the Board, relative to the introduction of a new water supply from Johnson's Pond in Boxford and Groveland, and as to the improvement of the existing supply by methods outlined by the engineer of the company. The Board replied to this application as follows: —

BOSTON, March 15, 1895.

Samples of water from your present source have been examined by this Board from time to time since 1889; and, while the water at first was of very good quality, it has been deteriorating in recent years, and there is no reason to expect that it will become better, but rather that it will continue to deteriorate.

The quality of the water might be improved by proper treatment, but there is uncertainty as to whether it could be made a wholly satisfactory water, and the cost of thorough treatment might be large in comparison with the cost of obtaining a satisfactory water in other ways; moreover, the capacity of the source is but little in excess of the amount of water now pumped. The Board, therefore, believes that the present source should be abandoned as soon as a better one can be made available.

The Board has caused examinations to be made by its engineers of all of the sources from which it seemed at all probable that a satisfactory supply for the town of Bradford might be obtained; and from this examination it concludes that there is no opportunity to obtain a satisfactory ground-water supply, and that Johnson's Pond is the most appropriate source from which to take a supply of surface water.

An analysis of water from this pond, taken in connection with an examination of the pond and its drainage area, shows that the water is of good quality, and suitable for all the purposes of a public water supply; and the pond will furnish a sufficient quantity of water to supply the towns of Bradford, Groveland and Boxford, and still leave as much water as is necessary to meet the requirements of the mills situated upon the stream which flows from the pond, for all purposes except water power.

The plan for improving the quality of the water from the present source during the construction of new works, as outlined in the report of your engineer, contemplates passing all of the water used through the existing distributing reservoirs, so that a portion of the iron contained in the water may become oxidized, and settle to the bottom of the reservoirs.

The plan proposed by him should cause a considerable improvement in the quality of the water, which might be increased somewhat if the water were pumped to a greater height than the water in the reservoir, and made to come in contact with the air as much as possible in falling. A still greater improvement would result if, in addition to letting the water drop through the air, it were given further opportunity for aeration by passing it through a filter composed of fragments of coke large enough to permit water and air to pass very freely. This filter should be situated above the level of the water in the reservoirs, and should have a surface area of about 400 square feet.

Brookfield. The water commissioners of Brookfield applied to the Board Feb. 6, 1895, for its advice relative to taking a public water supply from South Pond in that town. Advice was also asked as to the "use of this source in common by the towns of West Brookfield and Warren," in addition to Brookfield, through the medium of the same works. The Board replied to this application as follows: —

Boston, July 11, 1895.

The Board finds that the quality of the water at the northerly end of the pond is at times unfavorably affected by the back flow of water from Quaboag Pond, the water of which is, in its natural state, inferior to that of South Pond, and is also polluted by the sewage discharged into its feeders from the town of Spencer; but analyses of samples of water collected at a distance from the outlet of the pond show that if the back flow from Quaboag Pond is prevented, South Pond will furnish a water of excellent quality for all the purposes of a public water supply.

The quantity of water which the pond will furnish is undoubtedly much in excess of the quantity which will be required for the supply of the town.

In addition to the examinations of South Pond, the Board has caused a general examination to be made of other sources from which it seemed possible that a supply might be obtained, and has also caused analyses to be made of samples of water collected from these sources. These examinations were not carried far enough to be wholly conclusive, but they did not indicate that there was any more appropriate source than South Pond from which to obtain a supply for the town.

You also stated in your application that "advice is desired as to the suitability and sufficiency of this source for the towns of West Brookfield and Warren if supplied in common with Brookfield through the medium of the works as proposed by the latter town." It has already been indicated that if provision is made for preventing the back flow from Quaboag Pond the water of South Pond will be of suitable quality for water-supply purposes; and the quantity of water which this source will furnish is sufficiently large to supply all three towns for a long time in the future.

In the absence of any request for advice from the towns of West Brookfield and Warren, the Board has made no investigations for the purpose of ascertaining whether the three towns named can best obtain a supply of water by taking it from this source through the medium of a single system of works.

COHASSET. The Cohasset Water Company applied to the Board Nov. 22, 1894, for its advice relative to increasing their water supply by means of driven wells, or one large well, about 1,000 feet south of the present system of driven wells. The Board replied to this application as follows: —

BOSTON, July 11, 1895.

The Board has caused analyses to be made of samples of water sent in by you from one of the test wells at this place, and finds that the water is one which has at some time been polluted and subsequently very thoroughly purified by its passage through the ground. It seems probable that if water were pumped continually from a well or wells at this place, a part of the water would come from the populated territory north-east of the railroad, and that, in addition to showing to a still greater degree the effect of previous pollution, it might also be less perfectly purified by its passage through the ground. For these reasons the Board does not regard this source as a desirable one from which to take an additional water supply.

In view of the undesirable character of the water of the proposed source, the Board has caused a general examination to be made of other surface and ground-water sources in the vicinity of the town. It finds that the water of the surface sources has generally a high color and contains in most cases a large amount of organic matter, mainly of vegetable origin; and, while it is possible that at least one of these might be made to furnish a sufficient quantity of water, the quality of the water would not be nearly as satisfactory as that of a good ground water.

The examinations indicate that the most favorable locality in which to make investigations for a ground-water supply is in the vicinity of Bound Brook, above the village of North Scituate. The conditions here are not on the whole very favorable for obtaining a supply of this kind, but so far as could be judged from surface indications there is no more favorable locality within a reasonable distance of the town, and in view of the comparatively small amount of water needed, it seems possible that a satisfactory supply of ground water may be obtained at this place.

The Board will, upon application, advise you further in this matter when additional investigations have been made, and will furnish you with such information as may be in its possession concerning the various sources of water supply in the vicinity of the town.

DIGHTON and SOMERSET. An application was received Jan. 17, 1895, from James H. Flint and others (petitioners for incorporation as the Dighton and Somerset Water Company), for the advice of the Board relative to the taking of the waters of Muddy Brook and Segreganset River and their tributaries in the town of Dighton, and the water from any artesian or other wells which may be dug, bored or driven for the purpose in these towns, as sources of domestic water supply for Dighton and Somerset. The Board replied to this application as follows: —

BOSTON, March 25, 1895.

The Board has caused examinations of the proposed sources of supply to be made, as far as has been found practicable at this season of the year. Samples of water from Muddy Brook, Sunken Brook and the Segreganset River have been analyzed, and each has the brownish color and other characteristics which water acquires from contact with vegetable matter in swamps or shallow ponds, and on this account the water taken directly from either of these streams would not be of entirely satisfactory quality.

The water-sheds of both Muddy Brook and Sunken Brook are so small that they will not furnish enough water to supply the towns in a dry summer, unless a considerable amount of the water flowing in the wetter portions of the year is stored in reservoirs. There does not appear to be an opportunity for building reservoirs upon these streams of sufficient depth to prevent the water from deteriorating unless the reservoirs are deepened by excavating; and in order to obtain a sufficient amount of storage in this way the reservoirs would be very costly.

The Segreganset River has a much larger water-shed than the brooks above referred to, and can readily be made to furnish all of the water required for both towns.

A general examination was made of other sources, and there seemed to be more favorable opportunities for obtaining a water supply in Dighton than in Somerset; and, should it be found upon further investigation that, as now seems probable, the supply for both towns should come from sources in the town of Dighton, the two towns could be supplied more economically from one system of works than from independent systems.

Owing to the somewhat swampy character of the water flowing in most of the streams in this vicinity, it is desirable that a supply of good ground water should be obtained if possible; and the Board advises that investigations be made to determine whether it is feasible to obtain a supply of this kind, but cannot with its present information advise definitely as to the best place for making the investigations.

The Board will, if you so request, give you further advice later in the year, if you have more definite information to present as to the feasibility

of obtaining a ground-water supply, or should find a more satisfactory surface-water source.

On April 26 the Board received a further application from the same petitioners for further advice relative to the use of the water of Pine Swamp Brook and of the Segreganset River, or of so much of either source as may be necessary to supplement a ground-water supply. The Board replied to this second application as follows: —

BOSTON, May 25, 1895.

The State Board of Health received from you April 26, 1895, an application for further advice relative to using, for the water supply of the towns of Dighton and Somerset, the water of Pine Swamp Brook and of the Segreganset River, or so much of the water of either source as may be necessary to supplement the supply obtained from the ground. You also state that additional information has been obtained as to the character of the ground in the vicinity of these streams.

The Board in its last reply made the following statement: "Owing to the somewhat swampy character of the water flowing in most of the streams in this vicinity, it is desirable that a supply of good ground water should be obtained if possible, and the Board advises that investigations be made to determine whether it is feasible to obtain a supply of this kind," and concluded its reply as follows: "The Board will, if you so request, give you further advice later in the year, if you have more definite information to present as to the feasibility of obtaining a ground-water supply, or should find a more satisfactory surface-water source."

Further examinations and analyses made by the Board indicate that the waters of Pine Swamp Brook and the Segreganset River, owing to their brownish color and accompanying taste and odor, would not be of satisfactory quality for water-supply purposes unless taken indirectly by filtration through the ground.

The additional information submitted by you as to the character of the ground in the vicinity of these streams was obtained by driving three test wells near the junction of Pine Swamp Brook and the Segreganset River. These tests show that there is more or less porous material beneath the surface from which water can be pumped, and, although the conditions do not appear to be favorable for obtaining any very abundant supply of ground water, yet it may be feasible to obtain the comparatively small quantity needed for these towns by means of a well supplemented by collecting pipes or galleries extended for a sufficient distance up the valleys of the Pine Swamp Brook and the Segreganset River.

No samples of water were procured from the wells during the tests; but,

judging from the analyses of samples of water collected from a spring and from two wells not very far away, it is probable that the water to be obtained from the ground would be of good quality.

The examinations have been sufficiently extended to indicate that the ground in the vicinity of the Pine Swamp Brook and the Segreganset River is likely to be the best source within the limits of these towns from which to take a water supply; but the information at present available is too limited to enable the Board to give a definite opinion upon this point.

EDGARTOWN. An application was received from Joseph K. Nye, March 12, 1895, petitioner for incorporation as the Edgartown Water Company, for the advice of the Board relative to taking the water of certain springs in a valley south-west of the village of Edgartown as a source of public water supply. The Board replied to this application as follows: —

BOSTON, March 26, 1895.

The State Board of Health received from you on March 12, 1895, an application relative to a proposed water supply for Edgartown, Mass., which contains the following statement: "The proposed source of supply is from a tract of land situated about four thousand feet in a south-westerly direction from the village of Edgartown. The land is situated in a valley running in a south-easterly direction, the point of location being at the head of this valley, something over a mile from Edgartown Harbor. At this point are a number of springs, and it is proposed to drive a sufficient number of pipe wells to yield the required amount of water."

The Board has caused an examination of the locality referred to to be made by one of its engineers; but, as the ground has not been tested by driving wells or otherwise, it is impracticable at the present time to give any definite opinion as to the quantity and quality of water to be obtained from the proposed source. Judging from surface indications, however, it is not improbable that a sufficient quantity of water may be obtained from the ground in this vicinity; and, judging from experience with the water supplies of Cottage City and Vineyard Haven, which are derived from ground apparently similar in character, it is probable that the water will be of good quality.

The Board will advise you further upon this subject when you have made tests of the ground and have additional information to present.

GLOUCESTER. The Board received the following application July 3, 1894, from the mayor of Gloucester, for the advice of the Board relative to the water supply of that city: —

GLOUCESTER, MASS., June 30, 1894.

To the State Board of Health.

The city of Gloucester, by its duly appointed committee, desires and respectfully requests that further and more complete investigations of its present and prospective sources of water supply be made during this year, in order that safe and final conclusions may be reached by the city concerning the present and ultimate capacities of the sources from which water is now being actually supplied to the city, and those which may be added in reinforcement when an increase becomes necessary, among the latter to be included Chebacco Pond, with its tributaries and water-sheds. The city desires that the question of quality, in each case, be exhaustively considered; that present and future improvements which may be necessary to raise the quality to the highest degree attainable with reasonable economy be indicated; and that, so far as possible, some idea of the relative costs of making these improvements in each case be given.

Directions have been given to the city engineer "to obtain all records of varying depths of water in the present sources and kindred data which may have any bearing upon the case," and the city engineer will follow any suggestions which the Board may give in this line, and will promptly make such returns as the Board may indicate.

The city desires and respectfully requests that analyses of the waters of the sources involved be made with regularity during the remainder of this year, the samples to be taken simultaneously, if practicable.

For the joint special committee on water supply of the city of Gloucester,

(Signed) BENJ. F. COOK,
Mayor, and Chairman of Committee.

To this application the Board replied as follows: —

BOSTON, April 12, 1895.

In accordance with your request, an engineer of the Board visited your present and prospective sources twice in the month of July, 1894, and made arrangements for having samples of water taken from the present sources by your city engineer, acting in conjunction with a representative of the Gloucester Water Company, and from prospective sources by your city engineer. These samples were collected about once a month until February, 1895, making the total number of samples collected and analyzed 64.

From time to time your city engineer and Mr. Percy M. Blake, the engineer especially engaged upon the water-supply investigation, have furnished information and plans, giving the results of surveys and observations bearing upon the question of the capacity of present and proposed sources;

and, finally, we have received the supplementary report of Mr. Blake upon a municipal water supply for the city of Gloucester, dated March 9, 1895.

With the information thus furnished and that obtained by several examinations made by an engineer of this Board, the questions submitted by you have been carefully considered.

The conclusions reached by the Board as a result of this consideration are substantially the same as those contained in the reply to you upon the same subject, dated April 27, 1894, which were as follows: —

"The Board finds that the present sources have sufficient capacity in a dry year to supply the quantity of water now used by the city; but the population now supplied is much less than the total population, and the amount of water consumed is increasing from year to year, so that it will be necessary before long either to develop the sources now used or to obtain a further supply from other sources. If the present sources and those in their vicinity should be fully developed they would furnish fully double the quantity of water now used, and make a further supply unnecessary at the present time.

"The water supplied from the present reservoirs of the Gloucester Water Company is practically free from pollution by sewage, and in other respects it is a fairly satisfactory water for the purposes of a public water supply, and is somewhat better at the present time than the water in Chebacco Lake. It could undoubtedly be improved, however, by the removal of stumps, soil and vegetable matter from the bottom and sides of the reservoirs. The water from other sources near the present ones in West Gloucester has not been analyzed, but from an examination of these sources it seems probable that they will furnish as good water as the sources now supplying the city.

"Chebacco Lake will furnish a somewhat larger quantity of water than could be obtained from all of the available sources in West Gloucester if they were fully developed, and is probably the most available source of water supply for Gloucester, independent of the present works. As already indicated, the water is not quite as good as that now supplied to the city, and it is doubtful if it would prove a satisfactory water for water-supply purposes unless improved in some way, which cannot be determined with the information now available.

"The Chebacco ponds are located in the towns of Essex, Hamilton and Wenham, and are only a short distance from Manchester, and may prove the most available source of water supply or additional water supply for these towns; moreover, it is not improbable that they may prove the most available source from which to take an additional water supply for Salem and Beverly, when the capacity of the sources from which these places are now authorized to take water has been reached. Under these circumstances, the Board is of the opinion that the Chebacco ponds are not at

present the most appropriate source of supply for the city of Gloucester; and if rights in these ponds are granted to Gloucester, they should be limited by proper reservations for other places."

Now that further information is available and further examinations have been made, the Board is enabled to give more specific advice in some respects and to answer more fully the questions asked by you.

The Board now believes that the present sources and others in their vicinity can, at a reasonable cost, be improved and developed to such an extent that they will furnish about three times the quantity of water now used, and the quality of the water to be obtained from the added sources will be as good or better than that now supplied to the city from the present sources.

The nature of the work to be done to improve the quality of the water of the sources now used is, as indicated in the former reply, the removal of stumps, soil and vegetable matter from the bottom and sides of the reservoirs. In adding new sources the same policy should be pursued with regard to any reservoirs which may be built, and suitable channels should also be provided for collecting and conveying the water to the reservoirs in such a manner that it will not be injuriously affected by coming in contact with leaves, peat and other vegetable matter in swamps.

Chebacco Pond will furnish a somewhat larger quantity of water than all of the available sources in West Gloucester, when developed as above indicated; but the quality of its water is not quite as good as that supplied from the sources now used, and would compare still more unfavorably with the quality of the water to be obtained from the West Gloucester sources when improved and developed. The investigations thus far made have not shown that the quality of the lake water can be improved at what would be, at the present time, a reasonable cost.

The cost of taking water from Chebacco Lake would be considerably larger than that of properly developing all of the available sources in West Gloucester, with the further disadvantage in the former case that practically the whole expenditure has to be made at one time, while in the latter the expenditures for different additions and developments can be made from time to time, as an increased amount of water is needed.

If the city of Gloucester, by reason of its growth and the increased use of water, should reach the capacity of the sources in West Gloucester, Chebacco Lake will probably be at such time the most appropriate source from which to take an additional water supply.

Greenfield. An application was received from the selectmen of Greenfield, Nov. 30, 1894, for the advice of the Board relative to taking an additional supply of water for the town from the Green

River at a point near the "Poor Farm." The Board replied to this application as follows: —

BOSTON, March 15, 1895.

You state that it is the purpose to take water at a point on the west boundary of land owned by the town of Greenfield and known as the "Poor Farm;" and the Board has since been informed that the water is to be taken from a crib or well sunk in the gravel beside the river, rather than directly from the river itself. It is further understood that this supply is to be obtained by pumping, and is to supplement the present gravity supply from Glen Brook during the drier portion of the year.

The water of the Green River is somewhat harder than that obtained from the present source, but is not hard enough to be objectionable. In other respects the analyses indicate, as far as analyses can, that the water is of excellent quality for all the purposes of a public water supply. There is a risk, however, in taking water directly from a stream which has any population near it. But, in the present case, the risk is comparatively slight on account of the extremely small population. Still it would be advisable to take the water from a well sunk near the river, as proposed, in preference to taking it directly from the river.

Before sinking a well of this kind, examinations should be made to determine that the material adjacent to the river is porous to a considerable depth below the level of the water in the river; and, if such material should not be found at the point indicated in your application, the Board advises that you should make similar examinations of the ground beside the river near the point where Allen Brook enters it, as the examinations made by one of the engineers of the Board indicate that favorable ground in which to sink a well may be found at this place.

GROTON. The committee on water supply of Groton applied to the Board Jan. 12, 1895, for its advice relative to Baddacook Pond and springs near Cady Pond as sources of water supply for Groton. The Board replied to this application as follows: —

BOSTON, Nov. 4, 1895.

The Board has caused an examination of these sources to be made by one of its engineers, and samples of the water to be analyzed.

The quality of the water of springs near Cady Pond is excellent in most respects, but its hardness, which appears to be due to the presence of limestone in the ground through which the water percolates, is such as to make it very unsatisfactory for many of the purposes of a public water supply. There is much doubt also as to whether the quantity of water which the springs would furnish in a very dry season would be sufficient for the supply of the town after water shall have come into general use.

Baddacook Pond would furnish an abundant supply of water for the town, and chemical analyses show that its hardness would be only about one-third of that of the springs near Cady Pond. The water is somewhat colored, however, and contains a considerable amount of organic matter. Microscopical examinations, moreover, indicate that it may contain at times in summer a considerable number of minute organisms, which impart to water an unpleasant taste or odor.

With regard to the comparative merits of the two sources, it may be said that Baddacook Pond would be preferable as a source of public water supply, all things considered, to the springs near Cady Pond, but there is no doubt that if a source capable of furnishing a sufficient supply of ground water of good quality could be obtained, it would be more satisfactory than the water of Baddacook Pond. With a view to learning whether it was feasible for the town to obtain a ground-water supply within a reasonable distance, the Board has caused an examination to be made in a general way of the territory in the vicinity of the town. As a result of this investigation, the Board finds that the surface indications appear to be favorable to obtaining a considerable quantity of water from the ground at several places, the most favorable being in the vicinity of Baddacook Pond, particularly along the south-westerly side of the pond and in the valley of a small tributary which enters the pond on its westerly side. Chemical examinations of the water of springs in the latter locality indicate that the hardness of the water is about the same as that of the water of Baddacook Pond.

The Board would, therefore, advise that, before deciding definitely upon a source of supply, further investigations be made, with a view to determining whether it is feasible to obtain from the ground at either of these places a water of satisfactory quality and in sufficient quantity for the supply of the town. The Board will, upon application, advise you further in this matter when you have additional information to present.

HATFIELD. The selectmen of Hatfield applied to the Board Jan. 24, 1895, for its advice relative to taking the water of a brook in the westerly part of the town as a source of public water supply for Hatfield. The Board replied as follows: —

BOSTON, March 1, 1895.

At the time when an engineer of the Board visited Hatfield to examine the proposed source, there was so much snow upon the ground that it was not feasible to reach the site which your engineers regarded as most satisfactory for the proposed dam, but he succeeded in obtaining a sample of water from the brook between the upper and lower sites for the dam.

The analysis of this sample, taken in connection with the character of the water-shed, indicates that the water is of excellent quality for the purposes of a public water supply.

It was not feasible under the circumstances to judge from an examination of the locality whether the brook at the upper site will furnish a sufficient quantity of water for the town; but the report of your engineers of the measured flow in September, 1894, indicates that it will do so.

The Board regards the source as an appropriate one from which to take a water supply for the town of Hatfield.

HAVERHILL. The water board of Haverhill applied to the State Board of Health Jan. 15, 1895, for its advice relative to introducing an additional supply of water for Haverhill from East Meadow River in that city by constructing a dam and making a storage basin, the water to be pumped from this basin to Lake Kenoza, the source of the present high-service supply of the city. The Board replied to this application as follows: —

BOSTON, June 6, 1895.

Regarding this source of supply and the method of utilizing the water from it you make the following statement: —

"This additional supply for the city of Haverhill is proposed to be taken from the East Meadow River, in the easterly portion of the city, at Millvale, where it is proposed to construct a dam and create a storage basin. The area of the basin will be approximately 47 acres; the depth of water at the dam will be about 14 feet in the deepest place. The estimated capacity of this basin is 118,000,000 gallons. It is proposed to remove all mud and vegetable matter from the site of the basin. The area of the water-shed above the dam is approximately 7.75 square miles.

"A pumping station will be erected, with a pumping plant of sufficient capacity to pump all of the water needed in any year, during the five or six months of greatest flow. The water to be pumped through about one mile of twenty-four-inch pipe to Kenoza Lake, the source of the present high service supply of Haverhill.

"This lake has an area of 225 acres at elevation 110. The estimated storage capacity is 600,000,000 gallons in the upper ten feet in depth, or to the top of the intake of the new pumping station proposed to be built at Kenoza Lake in connection with this improvement.

"The difference in level of the Millvale basin and Kenoza Lake is 64 feet, the proposed high-water level of the former being at elevation 46.

"The plan of operation will be to pump the flow of East Meadow River into Kenoza Lake and store it there, using the storage in the Millvale basin if necessary.

"This basin will equalize the flow of the stream and allow of a pump being used of no greater capacity than the average daily flow for the month, or as much of it as is required by the consumption."

Your application was accompanied by the report and plans of your engineer, Mr. Freeman C. Coffin, relative to providing an additional water supply for your city.

The State Board of Health has, from time to time, for many years, analyzed samples of water from the present sources of supply, viz., Kenoza Lake, Crystal Lake, Round Pond and Plug Pond, and regards the water from all these sources except Plug Pond as of suitable quality at the present time for drinking.

The amount of water consumed by the city is not definitely known, because only the portion pumped from Kenoza Lake is measured, but, judging from the estimates made by your engineer and similar estimates made by an engineer of this Board, the average consumption of water during the three years from 1892 to 1894, inclusive, was 2,800,000 gallons per day, which is in excess of the capacity of the present sources of supply, exclusive of Plug Pond, in a series of dry years. It therefore follows that an additional supply should be provided at once, or that measures should be taken promptly to diminish the consumption of water.

The amount of water consumed in Haverhill is very large in proportion to its population, as will be seen by the following comparison with the consumption in other cities in the State where the manufacture of boots and shoes is the chief industry: —

Name of City.	Estimated Population in 1893.	Average Daily Consumption of Water in Gallons, 1892-94, inclusive.	
		Total.	Per Inhabitant.
Lynn (including Saugus),	68,378	3,770,000	55
Haverhill,	30,600	2,800,000	92
Brockton,	31,200	767,000	25
Marlborough,	15,524	441,000	28

There is no doubt that the consumption of water in Haverhill is unusually large, and that it would be feasible to diminish it by preventing the leakage and waste of water to such an extent that the present sources would supply considerably more than the present population.

Analyses of samples of water collected from the East Meadow River at the site of the proposed storage reservoir, together with an examination of the drainage area of this river, show that the water is practically free from pollution by sewage, but that it contains organic matter, and has a brownish color derived mainly from the swamps upon the water-shed; so that, if

conveyed directly to the city, it would be less attractive in appearance and probably less palatable than the water from the present sources.

This objection would be overcome to a large extent by pumping the water into Kenoza Lake. The mingled waters will be of much better quality than the water of the East Meadow River, and will bleach and otherwise improve in quality by storage in the lake. When it becomes necessary to take a large proportion of the water from the East Meadow River, it may prove desirable to improve the quality of the water of the river by thoroughly draining the swamps upon the water-shed, so that the water will not take up so large an amount of organic and coloring matter. If the population upon the water-shed of the river should increase materially, it may be necessary to take efficient measures to prevent the waste matters from entering the river.

Owing to the large size of the water-shed of the East Meadow River above the proposed dam, there is no doubt that the quantity of water which flows in the river during the year is much larger than the quantity flowing into all of the present sources; and, since the ponds and lakes now in use have a very large storage capacity, a large additional supply could be obtained by pumping the portion of the flow of the river which could be made available without constructing a storage reservoir upon it. A still larger supply, however, can be obtained by constructing the proposed storage reservoir upon the river, and if all of the mud and vegetable matter is removed from its site, as proposed by you, the quality of the water should improve rather than deteriorate by storage in this reservoir.

As the result of all of its examinations, the Board believes that the proposed source can be made to furnish a water of satisfactory quality, and that it is the most appropriate source from which to take an additional water supply for the city of Haverhill.

HOLDEN. The committee on water supply for the town of Holden applied to the Board Jan. 23, 1895, for its advice relative to taking the water of Pine Hill Reservoir in that town as a source of domestic water supply. The Board replied to this application as follows: —

BOSTON, March 19, 1895.

The proposed source would furnish an abundant supply of water, but the quality is likely to be somewhat unsatisfactory unless the town obtains control of and improves the reservoir, which was not originally prepared with a view to storing water for domestic use, and is now drawn very low in dry seasons for use at the mills below, and improves the quality of the water entering the reservoir by preventing the discharge of manufacturing wastes into it, and by draining swamps above the reservoir.

In addition to the objection that this water is not likely to be wholly satisfactory in quality, there is the further objection that the reservoir is not high enough to furnish by gravity an efficient fire service in the town.

In view of these unfavorable features of the source proposed by you, the Board has caused a further examination of Muschopauge Pond in the town of Rutland to be made, in order to ascertain whether this source, which has recently been considered in connection with a proposed water supply for Rutland, is not also an appropriate source of supply for Holden. This pond will furnish a water of better quality than Pine Hill Reservoir, and is high enough to provide by gravity an ample pressure for fire purposes in all parts of Holden, and the quantity of water is sufficient for both towns.

Measurements from the State map indicate that the additional length of main pipe required to take water from the pond instead of from Pine Hill Reservoir will be about 0.7 of a mile; but the advantages of taking a water supply from this source are so great that the Board regards it a more appropriate source for the town of Holden than the one proposed; subject, however, to the right of the town of Rutland to take as much water as it needs from the pond.

HOLYOKE. An application was received from the water board of Holyoke Nov. 29, 1895, for the advice of the State Board of Health, relative to a proposed additional water supply, to be taken from the south-west branch of the Manhan River at a point about two and one-half miles above Russellville.

The Board replied to this application as follows: —

BOSTON, Jan. 3, 1896.

The State Board of Health received from you on Nov. 22, 1895, an application with reference to a proposed additional water supply for the city of Holyoke, to be taken from the south-west branch of the Manhan River, at a point just below the confluence of the Manhan and Tucker brooks, about two and one-half miles above the village of Russellville in the town of Southampton. You propose at first to divert the natural flow of the brook through a twenty-inch or twenty-four-inch pipe into Ashley Pond, one of your present sources of supply, by gravity, and subsequently, when the increase in the use of water by the city makes necessary a larger supply than the natural flow of the brook will furnish in connection with present sources, you propose to construct storage reservoirs at favorable sites upon the stream and its tributaries.

Your investigations with reference to storage reservoirs upon the watershed of the proposed source indicate that a reservoir of a capacity of about

760,000,000 can be constructed on the Manhan Brook, about one and one-half miles above its junction with Tucker Brook, and that another reservoir of large capacity can be constructed at the junction of Manhan and Tucker brooks.

The Board has caused an examination of the proposed source of supply to be made and samples of the water sent in by you to be analyzed. These analyses indicate that the water of the proposed source is soft, and otherwise of good quality for domestic use.

This water-shed, when developed by the construction of storage reservoirs at the sites indicated, will, in connection with your present sources, furnish a sufficient supply for the city for a very long time in the future at the present rate of increase in population, if the consumption of water does not exceed about 90 gallons per inhabitant.

The taking of the proposed source by Holyoke does not appear to conflict with the interests of other growing communities in the vicinity, so far as the future water supply of these places is concerned, and the source is an appropriate one for additional water supply for Holyoke.

The question as to the size of pipe to be used for conveying water from the south-west branch of the Manhan River to Ashley Lake is largely one of cost, and depends to a considerable extent upon the future growth of the city. If the city should continue to grow for many years in the future at about the same rate that its past growth seems to indicate, there will probably be little difference in the ultimate cost whether a twenty-inch or twenty-four-inch pipe is used. If the increase in population and in the use of water should be less rapid in the future than in the past, a twenty-inch pipe would probably be somewhat more economical. There is an advantage in the use of the larger pipe, however, in that, even before its full capacity is required to prevent a shortage of water, it would be of great advantage in filling the present ponds and reservoirs in the spring, keeping them at a higher level in the summer, and maintaining a better quality of water.

Kingston. In the report of the Board for 1888 the following statement appears in regard to the water supply of Kingston: —

In the town of Kingston there are at present two water supplies, one of which, supplying water for about forty or fifty families, has for many years conveyed its supply to the houses for a considerable part of the distance in a lead pipe one and one-half inches in diameter. As there was some apprehension in the town lest injury might occur to the persons using this water, it was thought best to refer the matter to the State Board of Health. It was stated that in certain instances persons who used the water had been made ill. So far as could be learned, however, the

symptoms which had been referred to this cause were not indicative of lead-poisoning.

Samples of the water were obtained from the pipes at Kingston, and submitted to chemical analysis. The result of the analysis indicated that the water was dissolving quantities of lead, so minute that they could not be regarded as injurious to health; but the fact that any lead was dissolved by this water may imply that under certain circumstances the quantity of lead contained may be large enough to become injurious, and we are glad to learn that since the date of this inquiry the works of the Aqueduct Company have been bought by the town of Kingston, and the use of the lead pipe discontinued.

The public water supply of the town, after the general introduction of water and the discontinuance of the works of the old company, was obtained from a well near the mill-pond upon the Jones River. This was subsequently increased by means of a filter-gallery about three hundred feet in length, extending along the bank of the pond and river above the well. In 1891 the filter-gallery was still further extended to a length of about twelve hundred feet.

In August, 1895, information was received by the Board from several sources that persons using the water of the Kingston water supply exhibited well-marked symptoms of lead-poisoning. About the same time a verbal request was made by the Kingston water board that an analysis of the water supplied by the town should be made. The Board then caused an investigation to be made, which showed conclusively that at least twenty-five of the consumers of the water of the public supply at Kingston presented undoubted symptoms of lead-poisoning.

The following conditions were also found to exist: —

An unusually free use of lead pipe through the town. The service pipes were all of lead, and the average distance of the houses from the street is greater than that which prevails in most villages, so that longer pipes are necessary for supplying the houses. There are several instances in which houses are situated at an unusual distance from the street main, so that several hundred feet of lead pipe are used to connect the house with the main, and in these instances the most severe cases of lead-poisoning have occurred. In one instance, where there were long stretches of lead pipe, the people did not suffer, and in these cases it was found that care was

taken not to use the water which had remained in the pipes over night, but to let it run off before using. Samples of water were obtained from the taps at several houses, the water having been allowed to stand over night in the pipes, and in nearly every instance the amount of lead found to exist in such samples was found to be considerably beyond the limits usually regarded as dangerous to health. These amounts were found to be as high, in several instances, as $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{2}$ grains per gallon.

In consequence of the results of these investigations, the Board sent the following communication to the board of water commissioners of Kingston: —

Boston, Sept. 23, 1895.

The State Board of Health has considered your request for advice in regard to the healthfulness of the present water supply of the town, and, though not having completed its investigations, it has found that the use of lead pipes in the distribution of this water has seriously injured the health of many citizens of the town, and endangers the health of all who use the water so conveyed.

The Board, therefore, recommends the immediate removal of all lead pipes in the town, wherever they are used for conveying water for domestic use, either as service pipes or as street mains.

The general subject of lead-poisoning will receive fuller attention in a later report of the Board.

Leicester. An application was received from the water commissioners of Leicester, Jan. 29, 1895, for the advice of the Board relative to taking the water of Asnebumskit Pond in the town of Paxton as an additional source of water supply for Leicester. The Board replied to this application as follows: —

Boston, Feb. 5, 1895.

The State Board of Health received from you on Jan. 29, 1895, an application relative to taking an additional water supply for the Leicester water supply district from Asnebumskit Pond in the town of Paxton, and on the same day received an application from the selectmen of the town of Paxton relative to taking a water supply for that town from the same source.

The examinations made by the Board lead it to conclude that the water of this pond is of suitable quality for all the purposes of a public water supply, although it would be advisable to take first the water of certain

springs at the southerly end of the pond to the extent of their capacity on account of the better quality of the water, and to supplement the supply from these springs with water taken from the pond. The pond will furnish a sufficient quantity of water to meet the requirements of both communities, and from its situation with relation to the sources which at present supply Leicester with water by gravity and to the town of Paxton, the Board regards it as an appropriate source of water supply for both places.

LEOMINSTER. An application was received June 6, 1895, from the water committee of Leominster, for the advice of the Board relative to an additional water supply to be obtained by constructing reservoirs upon Fall Brook in that town. The Board replied to this application as follows: —

BOSTON, Aug. 12, 1895.

The State Board of Health received from you on June 6, 1895, an application relative to a proposed increase in the system of water supply of the town of Leominster, and subsequently (July 10) received from your engineer blue-print copies of your proposed plans, showing locations for three storage reservoirs on Fall Brook in the south-westerly part of the town.

The Board has caused an examination of the proposed source of supply to be made by one of its engineers, and has also caused the water of Fall Brook to be analyzed. The analyses show that the water has but little color, is soft, and is in other respects a surface water of good quality.

By constructing the lower reservoir on Fall Brook, as indicated on the plan submitted, the capacity of all works supplying the town will be increased to about 2,000,000 gallons per day in a very dry season, and possibly somewhat more, depending upon the amount of water lost by leakage. If all three reservoirs indicated on the plan should be constructed, the capacity of the works would not be further increased by more than about 100,000 gallons per day, an amount which would meet the increasing needs of the town for only a short time after the consumption of water reaches the capacity of the original works and proposed lower reservoir. No estimates of cost have been submitted, but it seems probable that estimates will show that the cost of constructing these reservoirs, or either of them, will be found too great in proportion to the increase in supply to be obtained thereby to warrant the expense.

The proposed lower reservoir, according to the plan, will cover an area of 82½ acres, a portion of which, amounting to 14.8 acres, consists of swamp and meadow land, the soil of which is mud or peat, extending in several places to a depth of more than 8 feet. Samples of soil collected from four test pits at different depths from 6 inches to 3 feet beneath the

surface in the swamp and meadow area indicate that the material of this area is composed very largely of organic matter.

It is understood that it is proposed to prepare the reservoir thoroughly for the storage of water by removing all the soil and vegetable matter from the area to be flowed, excepting from the swampy portions, and that these portions are to be covered with sand or gravel, or other suitable material from the sides of the reservoir.

The experience in this State where reservoirs have been thoroughly prepared for the storage of water by the removal of all of the soil and vegetable matter from the bottom and sides has been an extremely satisfactory one, and this method should be followed in the construction of the proposed reservoir wherever the depth of soil and vegetable matter is not so great as to render it very expensive. In the swampy portions of the reservoir, where the depth of peaty and vegetable matter is so great as to render it impracticable to remove it all on account of the great cost of the work, that portion of the peat around the edges of the mass where it is less than two feet deep should be removed, and all of the trees, bushes and stumps from the other portions, and the remaining swampy material covered with sand, gravel or other suitable material, free from organic matter. The covering should be sufficient to prevent the contact of the water with the mud, peat or other organic material, and a depth of one foot will probably be sufficient in all ordinary cases. The covering should be extended beyond the edges of the peaty material so as to cover them liberally.

While no reservoir in the State has been prepared in exactly this manner, it seems altogether probable that the quality of the water in the reservoir, if treated in this manner, will be satisfactory.

Investigations of the present sources of supply of Leominster show that the yield, while somewhat indefinite, owing to leakage from Morse Reservoir, is probably between 850,000 and 900,000 gallons per day in a very dry season, an amount sufficient to supply between 90 and 100 gallons per day to each inhabitant. From investigations made by your engineer it appears that the amount of water actually used in the town in a summer month when observations were made exceeded an average of 180 gallons per inhabitant per day. This is an excessive consumption, as in all the cities and towns of the State where records of the quantity of water consumed are kept, excepting the city of Boston, the amount used in the year 1893 averaged less than 100 gallons per inhabitant, and in many towns of about the same size as Leominster the consumption per inhabitant was only from 40 to 60 gallons.

The quality of the water of your present sources of supply, with the exception of Haynes Reservoir, as shown by examinations of the Board in this and previous years, is excellent. The water of Haynes Reservoir has been of bad quality in the summer in every year in which it has been ex-

amined by the Board. It is understood that a portion of the area covered by the reservoir was originally swamp and meadow land, and after an additional supply has been introduced an investigation of Haynes Reservoir should be made to determine whether the quality of the water cannot be improved at reasonable cost; otherwise, it is desirable that the use of the reservoir be avoided except at such seasons, if any occur, when the quality of the water is not objectionable.

LOWELL. The water board of Lowell applied to the Board Nov. 30, 1894, for its advice relative to the question of extending their driven-well system in the valley of River Meadow Brook in the town of Chelmsford. The Board replied to this application as follows: —

BOSTON, May 2, 1895.

It is learned from your annual report for 1894 that the average consumption of water during that year was 6,568,170 gallons per day, of which 4,272,617 gallons were pumped from the Merrimac River and the filter-gallery and filter-bed beside it, and 2,295,553 gallons from the original driven-well plant, which was first used in September, 1893.

It is understood that the first driven-well plant was put in by you in order to substitute a pure water for the river water, and not because of any deficiency in the quantity of water to be obtained by the existing works from the river; and, as you are probably aware, the State Board of Health regards the river water, when not purified by filtration, as a dangerous water to drink.

As the first driven-well plant furnished a substitute for only a portion of the water formerly taken from the river, the new plant in the town of Chelmsford is now being constructed in order to obtain a substitute for a part or the whole of the water which still has to be taken directly from the river.

Many analyses have been made from time to time of samples of water collected from the first driven-well plant, and, while there has been a slight deterioration during the past year, the water is of very good quality.

The new plant in the town of Chelmsford at the present time consists of a large number of wells driven on both sides of a long suction pipe, a short distance from and parallel with the old Middlesex Canal.

Six samples of water from these wells have been analyzed by the State Board of Health, five being collected under the direction of your city engineer and one by an engineer of the State Board of Health.

The first sample, collected on Jan. 24, 1895, was in every respect an excellent water. The second and third samples, collected respectively on March 4 and 20, had, after standing, considerable color for a ground water,

and contained more iron than is desirable in a water to be used for a public water supply, but in other respects were of good quality. It is understood that these samples were collected from the southerly half of the line of wells. The fourth sample, collected on April 3, from the northerly section of wells, was colorless, contained only an insignificant amount of iron, and was of excellent quality. The fifth sample, collected April 6, from a pump drawing water from 63 wells in the northerly and southerly sections, when 20 wells in the southerly section were shut off, had a scarcely perceptible color, contained a small amount of organic matter but more than any previous sample, and three times as much iron as the fourth sample but only about one-fourth as much as the second and third samples. The sixth sample, collected April 12, from the same pump, was of the same general character as the fifth sample.

The last two samples represent a larger number of wells than the others, and the water which they supply is of very good quality at the present time, but whether it will remain so when water is pumped continuously for a long time cannot be foretold with certainty with the present information.

Experience with the ground-water supplies in the State shows that in some cases the quantity of iron has increased and the waters have deteriorated in other respects with long-continued pumping, until it has become necessary to provide a new supply. In other cases the waters have remained unchanged after as many as twenty years of continuous pumping, but there is no case which has come to the attention of the Board in which long-continued pumping has improved the quality of the water.

Both the old and the new driven wells will derive a part of their supply by the filtration of water from River Meadow Brook, upon which the main village of Chelmsford is situated; and, while the water filtering from the brook in this way may become partially or wholly purified by its passage through the ground, the water of the brook should not be polluted by turning sewage into it.

The quantity of water drawn from the first driven-well plant during the year 1894 was 35 per cent. of the total quantity supplied to the city, and during the latter part of the dry portion of the year was a smaller percentage.

Judging from the quantities of water which have been pumped from the old and new systems of wells, and a careful study of all the conditions affecting the quantity of water to be obtained from them, the Board thinks it improbable that they will furnish more than half enough ground water in the drier portions of a dry year to meet the requirements of the city of Lowell; and the Board, therefore, urges you to proceed forthwith either to purify the water taken from the river or to obtain a further supply of pure water from some adequate source.

MONTAGUE (MILLER'S FALLS). The water supply committee of Miller's Falls applied to the Board Jan. 22, 1895, for its advice relative to the introduction of a public water supply for the village of Miller's Falls and the settlement known as Lake Pleasant by extending the pipes of the Turner's Falls water works. The Board replied to the application as follows: —

BOSTON, March 1, 1895.

Analyses of the water of this lake (Lake Pleasant) have been made at intervals for several years by the State Board of Health, which show that it is very soft and of excellent quality for water-supply purposes, and, with due care to protect it from pollution from the Lake Pleasant camp ground, it should remain of good quality.

It is not practicable at this season of the year, with the large amount of snow upon the ground, to determine how much water this lake will furnish. From such information as could be obtained, however, with the aid of the topographical map of the State, it seems probable that it will furnish a sufficient quantity of water for the village now supplied and the district which it is proposed to supply from it.

In view of all the circumstances, the Board is of the opinion that the proposed source of supply is an appropriate one for the villages of Miller's Falls and Lake Pleasant.

MONTAGUE (VILLAGE). An application was received Feb. 6, 1895, from W. H. Nims and others of Montague, requesting the advice of the Board relative to taking the water of certain springs about one-eighth of a mile south of the village as a source of public water supply for the village of Montague. The Board replied to this application as follows: —

BOSTON, Feb. 28, 1895.

It is understood that the water from the springs is to be collected into a small basin and well and pumped to an open distributing reservoir.

The Board has caused an examination of the source to be made, so far as was feasible at this season of the year, and an analysis of a sample of water collected from a brook flowing from the springs, and finds the water to be soft and in other respects of excellent quality for the purposes of a public water supply. If exposed to the light in open reservoirs the water is likely to be less satisfactory to the taste than if conveyed directly from the springs to the consumer, or stored in reservoirs from which the light is excluded.

The information in the possession of the Board is not sufficiently complete to enable it to predict whether this source will supply a sufficient

quantity of water for the village in a very dry season, but the indications are that it will do so.

PAXTON. An application was received from the selectmen of Paxton Jan. 29, 1895, for the advice of the Board relative to taking the water of Asnebumskit Pond as a public water supply for the town. The Board replied to this application as follows: —

BOSTON, Feb. 5, 1895.

The State Board of Health received from you on Jan. 29, 1895, an application relative to taking a water supply for the town of Paxton from Asnebumskit Pond, which is within the limits of the town, and on the same day received an application from the water commissioners of the Leicester water supply district relative to taking an additional water supply for Leicester from the same source.

The examinations made by the Board lead it to conclude that the water of this pond is of suitable quality for all the purposes of a public water supply, although it would be advisable to take first the water of certain springs at the southerly end of the pond to the extent of their capacity on account of the better quality of the water, and to supplement the supply from these springs with water taken from the pond.

The pond will furnish a sufficient quantity of water to meet the requirements of both communities, and, from its situation with relation to the town of Paxton and to the sources which at present supply Leicester with water by gravity, the Board regards it as an appropriate source of water supply for both places.

PEPPERELL. An application was received Oct. 10, 1894, from the water committee of the town of Pepperell, for the advice of the Board relative to the propriety of taking water for a public water supply from any source within the limits of Pepperell or from Rocky Pond in Hollis, N. H. The Board replied to this application as follows: —

BOSTON, Dec. 7, 1895.

The State Board of Health received from you on Oct. 8, 1894, an application with reference to a proposed water supply for the town of Pepperell, stating that permission would be asked of the Legislature to take water from any source within the limits of the town, and possibly from Rocky Pond in Hollis, N. H., if it should be high enough to furnish a supply by gravity. Subsequently a plan was submitted, indicating as the proposed source of supply a well near the Nissitissit River and just above the mouth of Sucker Brook in Pepperell.

A copy of a report by your engineer, relative to a water supply for the town, was submitted Feb. 8, 1895, proposing as a source of supply a collecting well to be located near the junction of the Nissitissit River and Sucker Brook, where it is thought that a considerable amount of water would be obtained from natural filtration through the ground from the river. A plan, which is understood to have accompanied the report of your engineer, was furnished by you in May, 1895. This plan indicates a collecting well near the Nissitissit River, just below the mouth of Sucker Brook, and a pumping station near the brook just above Brookline Street, and approximately 900 feet from the river. It is further stated in the report of your engineer, that, when required, a second smaller collecting well can be built farther up the brook in the Sartelle meadow, and the water carried by gravity to the proposed pumping station, a distance of about 7,500 feet; and it is suggested that in the trench in which the pipe to the Sartelle well would be laid a considerable amount of ground water would no doubt be encountered, and that this could be collected and taken in a tile pipe laid with open joints to the pumping station. It is further suggested that an additional supply might be obtained from the valley of Gulf Brook, above Smith & Willoughby's Pond, and delivered to the pumping station by gravity through a pipe 8,300 feet long.

The Board has caused a careful examination of the localities mentioned to be made by one of its engineers, and samples of ground water from a spring and a test well in the vicinity of the Sartelle meadow to be analyzed. The water of these samples was found to be of good quality except for its hardness, which would render it unsatisfactory for some of the purposes of a public water supply. No opportunity was found for obtaining samples of water from the ground near the mouth of Sucker Brook or in the valley of Gulf Brook.

With regard to the quantity of water to be obtained from the ground in the vicinity of the mouth of Sucker Brook by means of a well, as proposed, it is not feasible to make a definite statement, as no tests appear to have been made here to indicate the character of the soil; but, judging from the topography and the surface indications, the outlook appears to be very unfavorable to the existence of porous material beneath the surface here of sufficient depth and extent to yield enough water for the supply of the town.

The results of investigations made by you of the character of the soil in the vicinity of Sartelle meadow in the valley of Sucker Brook, by means of test wells, indicate that porous material is found beneath the surface here, from which water can be freely pumped, but that its depth is small, being in places less than 20 feet and nowhere exceeding 30 feet. The extent of the area of porous material has not been determined.

Farther down the brook, between the Sartelle meadow and Brookline

Street, in the region through which the pipe from the proposed well in the Sartelle meadow to the pumping station would be laid, test wells indicate that the material is a fine sand, from which it cannot be expected that any very large quantity of water can be collected by means of pipes laid with open joints, as proposed.

The investigations have not been sufficient to enable the Board to advise you definitely as to the probable quantity of water to be obtained from the proposed works in the valley of Sucker Brook, but with present information the indications are that the quantity of water which these works would furnish would not be sufficient for the supply of the town in the drier portion of a dry year, after water is generally introduced, and an extension of the collecting system would be necessary.

The investigations in the valley of Gulf Brook have not been sufficient to indicate definitely the character of the soil; but, judging from the information at present available, enough water might be obtained there to furnish, in connection with the proposed works in the valley of Sucker Brook, a sufficient supply of water for the town, though an extensive collecting system might be found necessary.

The situation of Rocky Pond in Hollis, N. H., beyond the limits of Massachusetts, must be regarded as a serious disadvantage to its use as a source of water supply for Pepperell. An analysis of a sample of water indicates that it is a water of good quality, and very soft. The area of the water-shed is not definitely known, but from present information it does not seem probable that the quantity of water which this source is capable of furnishing would be sufficient to meet the needs of the town after the water shall have come into general use.

From a general examination of other sources in the vicinity of the town, it is found that the surface indications in the valley of Unquetenassett Brook appear to be favorable to the absorption by the ground of a large portion of the water falling upon its surface; and, before deciding definitely upon a source of supply, the Board would advise that you cause an investigation of the ground in the valley of this brook to be made, to determine whether an adequate supply of soft water and of good quality in other respects can be obtained from the ground here, and the probable cost of works as compared with those proposed for taking water from the valleys of Sucker and Gulf brooks.

The Board will, upon application, advise you further with regard to this matter when you have additional information to present.

PITTSFIELD (the Onota Water Company). The Onota Water Company in Pittsfield applied to the Board March 29, 1895, for its advice relative to the introduction of water for domestic purposes for that part of Pittsfield near West Street, the proposed supply to be taken

from a source or sources in the adjacent town of Hancock. The Board replied to this application as follows: —

BOSTON, May 2, 1895.

The Board has caused an examination of the proposed sources to be made by one of its engineers, and a sample of water from the brook to be first used has been analyzed. This sample was collected and the examination was made at a time of year when much water from melting snow was flowing in the brooks, and it was, therefore, impracticable to judge accurately of the quantity or quality of the water during seasons of low flow.

The sample of water was found by analysis to be of excellent quality and to be soft, and, judging from the character of the water-shed, which is uninhabited, the water will be of good quality at all seasons of the year, though it will probably be harder during seasons of low flow than at the time the sample was taken.

The measurements which you have made of the dry-weather flow indicate that this source may furnish at all times an ample supply of water for the small population to be supplied from it at the present time, and, should it prove insufficient in the future, it seems feasible to enlarge the capacity of this source by building a storage reservoir or to obtain an additional supply from other brooks flowing down the easterly slope of these mountains.

The Board, therefore, regards the sources proposed by you as appropriate ones from which to take a water supply for the inhabitants of the high lands in the westerly portion of Pittsfield.

READING. An application was received from the water board of Reading March 15, 1894, for the advice of the State Board of Health relative to the purification of the public water supply of the town. The special points upon which information was desired, together with the reply of the Board, are indicated as follows: —

BOSTON, Feb. 18, 1895.

The State Board of Health received from you on March 15, 1894, an application asking for its advice with reference to a proposed system of purification for the water supply of the town of Reading, in which you state that your proposed additions are fully set forth on page 24 of your report for 1894. You further state that "The water board of Reading are anxious to ascertain from the State Board of Health: —

"*First.* — Whether the State Board has any suggestions to make as to the advisability of adopting the above system.

"*Second.* — Whether the State Board has any facts in its possession which will aid the water board of Reading in arriving at the best solution of their water troubles.

"*Third.* — Whether the State Board has any recommendations to make as to abandoning the present supply and seeking a new source.

"*Fourth.* — Whether, all things considered, the treatment in the method proposed is not the best thing that the town of Reading can do."

About one month later the Board received from the committee on water supply of the town of Reading a communication requesting the Board to examine the territory around the source of the Mystic River, with a view to a supply for Reading from that source, and to examine Silver Lake in Wilmington for the same purpose.

This application received the attention of the experts of the Board soon after it was submitted, but, owing to the nature of the advice asked for, it was necessary to determine the probable effect of the proposed treatment of the water at times when the meadow in which the filter-gallery is situated is covered with water, which did not occur until about the 20th of October.

A very large number of examinations of the water of the filter-gallery have been made during these investigations and previously, and from these results it appears that the objectionable character of the Reading water is due chiefly to the presence at nearly all times of an excessive amount of iron, in connection with other mineral and organic matter. The amount of iron found in the water varies greatly at different times, being very large in the portion of the year when the meadow is covered with water and much smaller during the summer when the meadow is dry. It has also been observed that the quantity of iron present in the water may vary greatly in the course of a single day's pumping.

In contrast with other waters in which a sufficient amount of iron has been found to affect the appearance and quality of the water, it has been found that the iron in the Reading water is present as a sulphate instead of being in the form of bicarbonate. When iron is present as a sulphate its removal from water is very much more difficult than when it is present as a bicarbonate.

Many experiments have been made at different times, with a view to a removal of the iron by oxidation and subsequent filtration of the water through sand to remove the precipitated iron oxide. The results obtained by this means have been very variable. But in general it may be said that when the iron is present in the water in small amount, say not over 0.3 of a part per 100,000, the iron will separate out of the water almost completely on exposure to the air for twenty-four to thirty-six hours, in the form of a rusty precipitate which can be removed entirely by filtration through sand at a rapid rate. This method is substantially that proposed by Mr. Desmond FitzGerald in his report to your board. Forced aeration by filtering through sand with a current of air was found in almost all cases to hasten the oxidation and separation of the iron oxide.

But in one case at least, when the iron was only 0.14 parts per 100,000, aeration in this way had but little effect on the iron. The failure to remove the iron in this case seemed to be connected with a considerable amount of organic matter in the water, which prevented the precipitation of the iron after oxidation.

Again, the difficulty in removing the iron appears to increase rapidly with the amount of iron in the water, and when large amounts are present, say from 1 to 2 parts per 100,000, which has been frequently the case the past winter, the means found adequate to remove the iron when present in small amounts are unavailing. Exposure to the air for two days had practically no effect on the iron contents of water of this character, and even after thorough aeration it separated out only in part, leaving most of the iron still in the water, upon which filtration had no effect.

During the progress of this investigation, advantage has been taken of the presence at the Reading pumping station of a small mechanical filter placed there and first operated about the middle of the summer. This filter consisted of two upright cylinders, one said to contain 30 inches in depth of sand, and the other 30 inches of bone-char, each having an area of about one square foot. Later in the season the number of cylinders was doubled.

Experiments with this filter showed that with iron not exceeding 0.1 of a part per 100,000, rapid filtration alone without exposure to air was capable of removing practically all of the iron in the water, but when the water contained larger amounts of iron the action of the filter was uncertain. With very high iron, say 1 part per 100,000, the filter had no effect whatever on the amount of iron. No special advantage was found in the use of bone-char in these experiments, and it is, therefore, probable that any sand filter capable of being readily and thoroughly cleaned would do equally good work.

Any treatment by filtration which will remove the iron will be very likely also to remove the objectionable odor and appearance of the water.

When the amount of iron in the water was very high, experiments were made to learn whether it could be removed by chemical means, a cheap form of which would be filtration through carbonate of lime (in the form of marble chips). The experiments in this line have indicated that the iron can be completely removed by filtration through carbonate of lime, but that in this process the water takes up lime in large amount, and is made very hard. A combined process of aeration and filtration through sand and with subsequent filtration through carbonate of lime leaves the water much less hard than when it is put directly upon a filter containing marble; and the results indicate that the hardness of the water after treatment in this way would be at least 16 to 18 parts per 100,000, while the hardness of the

water after filtration through carbonate of lime, without previous aeration and filtration through sand, is likely to be at least 25 parts per 100,000.

While the hardness of the water, if treated chemically, by filtration through carbonate of lime as suggested, would be very little or no greater than that of waters supplied to some of the towns in the vicinity of Boston, the Board does not recommend the use of so hard a water for a permanent supply.

Since the higher amounts of iron and organic matter are found when the meadow is flooded, it would seem that the quality of water in these respects might be greatly improved and the water rendered more susceptible of further improvement by filtration or other treatment, if this flooding were prevented.

The artificial flooding could be prevented by keeping the gates at the dam open, but this might not prevent the flooding of the meadow during periods of very high flow in the stream; but this flooding would be of short duration, and would not affect the quality of the water nearly as much as the present flooding, which lasts for many months. The flooding could be wholly prevented by building dikes.

Examinations of the ground in the vicinity of the Ipswich River, between one and two miles above your present works, by means of test wells driven by your Board, were favorable in respect to quantity; but the water of the wells was found on analysis to contain so much iron that its quality would be likely to be unfavorably affected from this cause, if a supply should be taken from the ground in this locality. A similar examination in the water-shed of Lake Quannapowitt, south-east of the village and near the Wakefield boundary, gave similar unfavorable indications as to the quality of the ground water to be obtained in that region.

A sample of water collected from a tubular well located in the area known as the Bancroft meadow was found on analysis to be of excellent quality; but the area from which water drains toward this meadow is so small that it is improbable that any large supply of water could be drawn continuously from this source.

Other territory within the limits of the town was examined, but at no place were the surface indications sufficiently favorable to afford a reasonable expectation that a supply of water of satisfactory quality and in sufficient quantity for the supply of Reading could be obtained.

The right to a supply from Martin's Pond has already been granted to the city of Malden, and the Board has already stated, in a reply to that city (annual report for 1892, page 28), that it does not consider it feasible to obtain a satisfactory supply directly from this pond. Investigations made recently by that city with a view to taking a supply from the ground in the vicinity of this pond have been unfavorable, and at the present time

it does not seem probable that Malden will build works for taking its supply from this source.

A supply from the head-waters of the Mystic River would have to be taken above the chemical works near South Wilmington, in order to avoid danger of pollution from those works. The water-shed here is too small to furnish a sufficient supply without storage, and there appears to be no good site for a storage reservoir of sufficient size; moreover, this territory is within the Mystic water-shed, which is inadequate for the supply of the cities now supplied from it.

No investigations of the ground at this place have been made, but, owing to the small size of the water-shed, the conditions beneath the surface would need to be exceptionally favorable to obtain any considerable amount of ground water from this source.

Silver Lake, in Wilmington, has an area of about 32 acres and a very small superficial water-shed. It may, however, yield more water than is indicated by the size of its water-shed, because it is surrounded by extensive areas of sandy soil.

Judging from the surface indications and from the character of the material obtained from two test wells driven in the vicinity, it is not improbable that investigations would show that enough good water might be obtained from the lake or from the ground in the vicinity of the lake or of Lubber Brook, which flows very near it, to supply Reading and Wilmington; but the amount and quality of the water can only be determined with certainty after the ground has been thoroughly tested and samples of the water examined.

As you are aware, the State Board of Health has recently submitted to the Legislature a report upon a general system of water supply for the metropolitan district about Boston; and, while Reading is situated outside of the ten-mile limit referred to in the act under which this report was made, there seems to be no reason why it may not be included among the places to which this supply is to be furnished.

No data are at hand upon which to base a definite estimate of the probable cost of works for the supply of Reading from Silver Lake; but the yearly cost of obtaining a supply from this source would probably exceed considerably the cost of a supply as a part of the metropolitan water district.

With its present information, the Board advises the town of Reading to take measures to obtain its future supply as a part of the metropolitan water district, and to abandon its present source when the new supply becomes available. In the mean time, provision should be made to improve the present supply by preventing the flooding of the meadow over the filter-gallery, and it may be advisable to adopt, temporarily, some system for filtering the water rapidly through sand.

Rutland. The committee on water supply of the town of Rutland applied to the Board Dec. 24, 1894, for its advice relative to taking the water of Lake Muschopauge in that town as a source of water supply for the town. The Board replied to this application as follows: —

Boston, Feb. 23, 1895.

The examinations made by the Board lead it to conclude that this pond will furnish a sufficient quantity of water of suitable quality for all the purposes of a public water supply, and that it is, therefore, an appropriate source of supply for the town.

Sheffield. H. S. Andrews and others of Sheffield applied to the Board Nov. 20, 1894, for its advice relative to taking the water of certain springs in that town, about two and one-half miles north-east of the village, as a public water supply for Sheffield. The Board replied as follows: —

Boston, Feb. 23, 1895.

It is understood that it is proposed to intercept the flow from springs, and to store the water in small reservoirs from which it will flow by gravity to the portions of the town to be supplied.

The samples of water collected from the springs early in January, 1895, have been found by analysis to be very soft, and of excellent quality for the purposes of a public water supply. If exposed to the light in open reservoirs the water is likely to be less satisfactory to the taste than if conveyed directly from the springs to the consumer, or stored in reservoirs from which the light is excluded.

With regard to the quantity of water, it is not feasible to tell with certainty from the present information whether or not a sufficient supply can be obtained from the springs, but the prospects are favorable; and, if the supply should prove insufficient during a portion of the year, it appears probable that it might be supplemented from a small brook which flows near the springs, by constructing a storage reservoir upon it above them.

The Board regards this source as an appropriate one from which to take a supply of water for the town.

Shirley. An application was received Nov. 5, 1895, from the selectmen and committee on water supply of the town of Shirley, for the advice of the Board relative to taking water from Leatherboard Pond in that town as a public water supply. The Board replied to this application as follows: —

BOSTON, Dec. 5, 1895.

The quantity of water which the proposed source is capable of furnishing is ample for the use of the inhabitants of the town of Shirley. With regard to quality, however, the water of this source would be very unsatisfactory, owing to its high color and unpleasant odor, as indicated by a sample collected Nov. 13, 1895, due to its contact with vegetable matter in the large swampy area within the water-shed of Bow Brook above the point where it enters the pond. The character of the pond itself, moreover, is not such as to influence favorably the quality of the water, as it is very shallow, and the bottom appears to be covered in places with mud and vegetable matter. The quality of the water may also be greatly influenced at times by the condition of the water in Fort Pond, situated near the upper end of the water-shed of the brook. This pond is used as a storage reservoir, and its water is drawn off during the drier portion of the year through Leatherboard Pond, to assist in maintaining the flow of the stream below. A sample of water, collected from Fort Pond November 13, contained a very large number of organisms, mostly of a kind which is liable to produce offensive tastes and odors, and this water in its present condition would be very unsatisfactory for domestic purposes. It is not feasible to tell whether the water at the present time is better or worse than at other seasons of the year, but it may be said that as a rule the quality of the water of ponds is worse in summer.

In view of the poor quality of the water of Leatherboard Pond and the unfavorable character of its water-shed, the Board does not advise its adoption as a source of water supply for the town of Shirley.

While the Board is not fully informed as to the feasibility of obtaining a satisfactory supply from some other surface source in the vicinity of Shirley Village, it seems probable, with present information, that a ground-water supply of good quality, if such a one can be obtained, would be more satisfactory for the town than any surface-water source in the vicinity; and the Board advises that it is desirable in making further investigations for a water supply, to determine the feasibility of obtaining a satisfactory supply in this way, but cannot with present information advise definitely as to the best place for making investigations.

The Board will, upon application, advise you further in this matter when you have the results of further investigations to present.

STOUGHTON. An application was received from the Stoughton Water Board Jan. 16, 1895, for the advice of the Board relative to introducing a supplementary supply of water, in accordance with methods and plans presented by their engineer. To this application the Board replied as follows: —

BOSTON, April 4, 1895.

One of these plans provides for collecting the water of the springs which outflow at the edge of the low land surrounding Muddy Pond, and is, in its general features, the plan recommended by the State Board of Health in its communication to you dated Oct. 13, 1893, a copy of which is enclosed herewith. The other plan provides for taking water from a well located about 1,150 feet above the present pumping station, on a point of land at the junction of Muddy Brook and the brook flowing from Stoughton village.

In choosing between these two plans, the most important features are, obviously, the quantity and quality of water which they will furnish.

With regard to the quantity of water which the first plan will furnish, it may be said that the communication above referred to stated that the total flow of the springs, as represented by the outflow from Muddy Pond on April 26, 1892, was 1,410,000 gallons per day, and on Sept. 11, 1893, fully 1,000,000 gallons per day. Measurements made under the direction of your engineer from Sept. 24 to Oct. 4, 1894, show that the flow ranged from 435,000 to about 900,000 gallons per day. A measurement made on March 15, 1895, showed that the amount was upwards of 1,500,000 gallons per day. The lowest of the above quantities is considerably more than enough for the present population of the town, with any ordinary rate of consumption of water per inhabitant; but it is enough smaller than the other measurements to indicate the possibility, under extreme conditions, of an insufficient flow from the springs, making it necessary to have recourse to some surface-water or other supplementary source at such time. Of the excellence of the water to be obtained from this source there is no doubt, provided it is intercepted, as advised in the last communication, before the water has been exposed to the light or come in contact with the vegetable matter in the swamp surrounding the pond.

The tests made near the site of the well proposed by the second plan show that there is a thick layer of porous gravel underlying the fine sand found for a considerable distance down from the surface, and from the gravel water can be pumped very freely. Judging from the freedom with which the water can be pumped from several of the test wells, there seems to be no doubt that when the ground is full of water a well or wells at this place will furnish it at a rate sufficient for the supply of the town, and the question of a supply from this source depends mainly upon whether there will be a gradual lowering of the water in the ground during dry seasons, with a corresponding diminution in the amount of water which can be pumped from the well.

From all the information now available, it seems probable that the springs at Muddy Pond will furnish more water both in wet and in dry seasons than the proposed well.

A sample of water collected from one of the test wells near the site of the proposed well was analyzed and found to be of excellent quality, but this sample does not necessarily indicate the quality of the water to be obtained by continuous pumping from the well. It does not seem at all probable that the well will furnish a sufficient quantity for the supply of the town, unless the water in it is drawn below the level of the adjacent millpond, and a considerable amount of water filters from this millpond and from others further up the stream coming from the village to maintain the saturation of the ground about the well. The water filtering in this manner might be thoroughly purified by its passage through the ground to the well; but this is somewhat uncertain, and the filtration would not soften the water of this stream, which is hard, owing to its pollution. For both of these reasons the water to be obtained from the well must be regarded as inferior in quality to the unpolluted spring water.

If the plan for taking water from the springs were to be adopted, it would be advisable, unless an abundant supply of water was developed by extending the pipe to the point indicated by your engineer, to extend it still further, so as to intercept the springs entering the pond from the easterly side; and throughout the territory where the springs outflow it is desirable that the line of the pipe should be moved in toward the foot of the high land, if by so doing quicksand and mud can be avoided, and the trench placed in a more porous, gravelly material. It would also be advisable, as suggested in the last communication, to lay smaller branch pipes to intercept the spring water at the places where it outflows in the greatest quantity.

In addition to the proposed well, the plan recommended by your engineer provides for the construction of a small reservoir just above the Southworth Dam, now owned by the town, on Muddy Brook, which would have some effect, particularly when first constructed, upon the amount of water to be obtained from the proposed well, and the reservoir is also intended as a supplementary source from which to take water directly if the supply from the well should prove insufficient. If the supply were to be taken from the springs, the pipe leading from them would pass near and below the level of Muddy Pond, from which water might be taken in a very dry time if the supply from the springs should prove insufficient; or, if it should be deemed necessary to have a large quantity of water in reserve near the pumping station, such a reserve could be provided in connection with the plan for taking water from the springs as well as in connection with the other plan.

Reference is also made in the report of your engineer to the expediency of taking a supplementary or an independent supply of water from Knowles Brook. Owing to the fact that your pumping station is located in the valley of Muddy Brook, and the probability that a larger supplementary supply of excellent water can be obtained from the valley of this brook

than from Knowles Brook, it seems clearly undesirable at the present time to take the additional supply from the latter source.

WALPOLE. The water commissioners of Walpole applied to the Board March 29, 1895, for its advice relative to the introduction of a public water supply from the ground in the valley of Low Brook, about one-half mile above its junction with the Neponset River. The Board replied as follows: —

BOSTON, June 7, 1895.

The subject of a water supply for Walpole was brought to the attention of this Board by an application of the committee on water supply of the town in 1893, and the Board on June 5 of that year made the following reply: —

"The investigations made near the Neponset River, not very far above the Blackburn water privilege and just below Low Brook, showed very satisfactory results as regards the porosity of the material, the freedom with which water could be pumped from the test wells and the quality of the water. Taking these results in connection with an examination of the surrounding territory and the size of the streams, the Board finds no reason to doubt that an ample supply of excellent water can be obtained from a well or wells located in the porous material in this vicinity."

Judging from the tests which you have made by driving wells and pumping from them at the source now proposed in the valley of Low Brook, the results at this place are also very satisfactory as regards the porosity of the material and the freedom with which water could be pumped from test wells, and analyses show that the water is of excellent quality. The watershed and streams which must be depended upon for maintaining the saturation of the ground at the new location are much smaller than at the former one near the Neponset River, and, judging from all of the information at present available, the source near the Neponset River would be likely to furnish the larger quantity of water. It is not improbable, however, that wells at the new location would supply the town with all of the water required for ordinary water supply purposes for several years; but if, as has been suggested, large quantities of water are to be supplied for manufacturing purposes, the source now proposed would probably prove inadequate.

There is uncertainty, in nearly all cases where water is to be taken from a ground-water source, as to just how much water the source will furnish at the end of a long-continued drought; and, as it is very desirable that you should obtain as large a quantity of ground water as possible, the Board advises you, before finally locating your wells and pumping station, to make further investigations, with the aid of an engineer skilled in the

selection of ground-water supplies, having in view the location of the works at the place where the largest quantity of water of satisfactory quality can be obtained, either from the original works or from extensions to be made subsequently.

WENHAM. An application was received from the selectmen of Wenham, Feb. 18, 1895, for the advice of the Board relative to taking the water of Pleasant Pond in that town as a source of public water supply. The Board replied to this application as follows: —

BOSTON, March 25, 1895.

The Board has caused an examination of this source and an analysis of a sample of water collected from the pond near its outlet to be made. This pond will furnish an abundant supply of water for your town, and the water is of fair quality, but not as good as it is desirable to introduce into the town if a better water can be obtained.

The unsatisfactory character of the water is due to the surface drainage from the streets in a portion of the village, the drainage from a small swamp south of the main street and much larger swampy areas south of the pond, and the percolation of polluted waste water from a portion of the village through the ground into the pond or its feeders.

It was suggested by one of your board that most of the street wash above referred to, and the drainage from the small swamp south of the main street, might be diverted from the pond and made to flow in a southerly direction to Miles River; and this would have a tendency to improve the quality of the pond water, but it would not be likely to make enough change in the quality to make the water wholly satisfactory.

If a public water supply were introduced from any source, without at the same time providing a system of sewers, there would be more polluted waste water turned into the ground than at present, and more would find its way by percolation or otherwise into Pleasant Pond. These waters, even if thoroughly purified by percolation through the ground so that they would not be dangerous to health, contain soluble matters which would promote the growth of the minute organisms which frequently give waters stored in ponds and reservoirs a disagreeable taste and odor.

It is possible that investigations may show that a water which is entirely satisfactory in quality can be obtained from the ground near the pond, or from some other ground-water source within the limits of the town. The Board also calls attention to the fact that the pumping stations of the water works of Beverly and Salem are but little more than a mile and a half from the centre of Wenham village; and if arrangements could be made whereby these cities or either of them would furnish water at a small advance upon

its cost, the water would probably cost the town of Wenham much less than if obtained by the construction of independent works.

The Board will advise you further in this matter, if you so desire, when you have further information to present for its consideration.

WESTFIELD. The committee on additional water supply of the town of Westfield applied to the Board Jan. 28, 1895, for the advice of the Board relative to the taking of Munn Brook in Granville at a point near its junction with Tillotson's Brook, as an additional source of water supply for Westfield. The Board replied to this application as follows: —

BOSTON, Feb. 6, 1895.

The water commissioners of the city of Holyoke applied to this Board on June 13, 1893, and again on Jan. 18, 1894, for its advice relative to taking an additional water supply from this source, and the replies of the Board to these applications are transmitted herewith. You will find in them the opinion of the Board with regard to the quality of the water so far as it has information up to the present time.

The city of Holyoke is in urgent need of an additional water supply, and the Board has in one of the replies expressed the opinion, which it still holds, that Munn Brook is the most appropriate source from which to take an additional water supply for the city of Holyoke; but the Board also believes that the brook is an appropriate source of additional supply for the town of Westfield, provided it is taken jointly by the two communities. The construction of works for the joint supply of the two communities would materially lessen the cost to each, if arrangements were made for an equitable division of their cost; and, although the capacity of the source would be reached sooner if it were used by the two communities than by either one, it will continue, with proper development by the construction of storage reservoirs, to supply both for a considerable time, and the supply can be supplemented from the Westfield Little River in the future if the supply from Munn Brook should prove insufficient.

The Board, therefore, advises you to consider the question of obtaining an additional supply from this source in connection with the city of Holyoke.

WESTON. Charles H. Fiske and others, petitioners for incorporation as the Weston Water and Electric Company, applied to the Board April 30, 1895, for its advice relative to taking a water supply for the town of Weston from springs in the neighborhood of Central Avenue in that town. The Board replied to this application as follows: —

Boston, Aug. 2, 1895.

The analysis of water from the test wells nearest Central Avenue showed that it had at some time been polluted and subsequently well purified by its passage through the ground, while the analysis of the water of one of the wells on the farther side of the meadow from Central Avenue showed only a slight trace of previous pollution and a very thorough purification of the water by its passage through the ground. This water, as it came from the ground, except for a slight turbidity which would disappear after the wells were in constant use, was of excellent quality for all the purposes of a public water supply; but it is not improbable that the continuous draught of water from the ground at this place would cause the water which stands upon the meadow to filter downward, thereby making the water less attractive and palatable, and causing it to take up enough iron to render it unsuitable for laundry purposes.

The Board, therefore, advises you, before putting in works in this vicinity, to make further tests by driving wells in the low, sandy land lying between the meadow and the railroad; and, if these tests should show the existence of pervious material from which water of good quality can be pumped freely to a depth of 25 feet or more below the level of the meadow, it would then be advisable to locate the wells in the hard ground as far from the meadow as possible, as the water obtained in this way would be much less likely to deteriorate than if the wells were sunk in the saturated meadow.

The Board will advise you further in this matter, if you so request, after the additional tests have been made.

Williamstown. The Williamstown Water Company applied to the Board Sept. 16, 1895, for its advice relative to taking Flora Glen Brook as an additional source of water supply for that town. The Board replied to this application as follows: —

Boston, Oct. 23, 1895.

The Board has caused the proposed source of supply to be examined by one of its engineers, and a sample of the water to be analyzed. The analysis indicates that the quality of the water is excellent, and its hardness much less than that of the water of Sherman Spring and only about one-third of that of the water of Cold Spring, your present sources of supply. With the amount of storage proposed, a large addition to your present supply can be obtained from this brook, and, with properly prepared reservoirs, the quality of this water is likely to be more satisfactory to consumers than the water of either of the two springs now used as sources of supply, on account of its comparative softness.

It is improbable that your present and proposed works together will furnish as much water as ought to be provided for a growing town like Williamstown; and the development of small sources, that are likely to prove inadequate in a very few years if the town continues to grow, or if there should be a large increase in the use of water, is not in the interest of true economy. The Board would, therefore, advise that, before making further additions to the works, you have a thorough investigation made, with a view to determining the best source for the permanent supply of the town.

WINCHENDON. The committee on water supply of Winchendon applied to the Board Jan. 31, 1895, for further advice in regard to the Prentiss meadow in that town as a source of water supply for the town. The Board replied to this application as follows: —

BOSTON, May 15, 1895.

The State Board of Health received from you an application dated Jan. 31, 1895, for further advice with regard to the Prentiss meadow as a source of water supply for your town, and with this application you have submitted a report of your engineer, giving the results of certain pumping tests and investigations which have been made in order to determine the capacity of this source.

The water supply of Winchendon has been the subject of careful consideration by this Board on several occasions, and your attention is again called to the replies made by the Board to your committee on February 17, April 6, August 3 and September 10 of last year, for a general consideration of the subject of the water supply for your town and an extended consideration of the Prentiss meadow source, concerning which you now ask further advice.

Before referring to the reconsideration of the subject with the aid of the new information furnished, it may be well to state that the reply of the Board, dated Sept. 10, 1894, after referring to a method of estimating the quantity of water to be obtained from a ground water source, stated: "Upon this basis the engineers of the Board have estimated that a well or wells in the Prentiss meadows would yield during the driest four months of a dry year about 130,000 gallons per day." Again, after calling attention to the fact that the capacity of a ground-water supply cannot be determined with nearly as much accuracy as of a surface-water supply, the further statement was made: "While, therefore, the Board estimates that the quantity of water to be obtained from a well or group of wells in the Prentiss meadow would be from 100,000 to 200,000 gallons per day, it cannot be at all definitely stated that the quantity may not be even more or less than these figures."

From the information contained in Mr. Fuller's report and additional

information furnished directly by him, it is learned that one test was made by pumping day and night for thirty-seven days, from a well about 20 feet deep and about 8 or 9 feet in diameter at the bottom. This test began on Sept. 3 and ended on Oct. 10, 1894. During rather more than the first half of the test no measurements of the quantity of water pumped are given, but it is stated that the flow was probably somewhat more than during the last fourteen days when the measurements were taken. The water in the well was kept pumped down to within one foot and nine inches of the bottom of the well, so that the quantity pumped represented substantially all of the water which the well would furnish. The average quantity of water pumped per day during the last fourteen days was 271,000 gallons, and there was a gradual lowering of the water in the ground in the vicinity of the well.

A second test was made by pumping for seventeen days, from Dec. 19, 1894, to Jan. 4, 1895, from ten driven wells, the nearest of which was about 300 feet from the dug well, and during the last three and a half days of this test water was also pumped from the dug well. The amount of water pumped from the driven wells averaged 245,000 gallons per day, but there was a very large reduction in the quantity pumped per day during the last thirteen days of the test. The dug well supplied an average of 296,000 gallons per day during three and a half days, but even in this short time there was a noticeable reduction in the amount of water pumped. At the conclusion of this test the water in the dug well rose to its normal level much more slowly than after the first one.

In interpreting the results of these tests, it is necessary to take into account the rainfall at and before the time when they were made and the season of the year as affecting the proportion of the rainfall, which was likely to soak into the ground and aid in maintaining the supply during the tests.

The rainfall at Winchendon during the first test, as reported by the Weather Bureau, was 8.66 inches, and during the second test 1.26 inches. The rainfall during the last four months of the year, as compared with the average rainfall in Massachusetts during the same months and with the rainfall in a very dry year, is given in the following table: —

Month.	Rainfall at Winchendon, 1894 (Inches).	Average Rainfall in Massachusetts (Inches).	Rainfall in a Very Dry Year (Inches).
September, ...	7.09	3.31	1.60
October, ...	2.63	3.87	3.74
November, ...	2.06	3.96	1.78
December, ...	3.25	3.57	2.83
Total, ...	15.03	14.71	9.95

The table shows that the tests were made during months when the rainfall was, on the whole, slightly above the average. The season of the year also has an important bearing, because during the warmer months the greater part of the rain which falls goes off again into the air by evaporation, while in the cooler months of the year, until the ground is solidly frozen, a much larger proportion remains to soak into the ground. A large allowance, therefore, has to be made, in order to insure an unfailing supply, to offset the diminished yield during seasons of lower rainfall and during the warmer portions of the year when more water evaporates. It should also be noted that, even during the season of comparatively large yield when the tests were made, the water in the ground continued to lower, and with continuous pumping for a much longer time it is probable that the wells would have yielded less water than they did during these comparatively short tests.

The estimates of the capacity of a well or wells at this place, as formerly made by the engineers of this Board, related to the yield during the driest four months of a dry year, and were based in part upon the exhaustion by long-continued pumping of the water stored in the ground in the vicinity of the wells; and, now that the tests have been made, we are unable to conclude that the quantity of water obtainable under these conditions would exceed the amount originally estimated, — an amount too small to supply the town after water shall have begun to be generally used.

Your engineer suggests in his report that the ground surrounding the wells may be kept saturated by introducing water from the river by means of drain pipes with open joints, placed as much as 100 feet from the wells. The Board regards this method of supplementing the supply as an impracticable one, mainly because the matters strained out of the river water would accumulate where the water passes from the joints of the pipe into the ground; and, as they could not be removed, the filter would before long become clogged and inoperative.

The Board, in its former investigation of this subject, considered various methods of extending the collecting system and maintaining the saturation of the ground by water taken from the river, and, after indicating methods which might be adopted, made the following statement: —

"Taking into account the first cost of this complicated system of works, the yearly cost of operating them in such a way as to obtain a sufficient supply of good water and the uncertainty as to the results which would be obtained, it does not seem advisable to adopt this plan, when you may obtain from Upper Naukeag Pond, by a simple plan and probably with a much smaller annual cost, an ample supply of water of good quality."

Since the Board, after a careful consideration of all of the information furnished by your extended investigations, does not have occasion to modify its former estimates as to the probable capacity of a well or wells

at the Prentiss meadow, or to change its conclusions with regard to supplementing the supply to be obtained from the ground at this place, it has no occasion to modify the advice already given to you with regard to this source of water supply.

All of the analyses of water from Upper Naukeag Pond show it to be of better quality for water-supply purposes than the water usually obtained from ponds. Six years ago the water had a disagreeable odor, such as has been found occasionally in nearly all of the surface-water supplies of the State, including some of the best ponds; but this odor, though disagreeable, is not known to be injurious to health. No trace of the odor has been found in the water of Upper Naukeag Pond for six years; and, with the results of your investigations in view, the Board is unable to advise that there is within your reach any other source as desirable as this.

In response to the request contained in a communication dated March 6, 1895, the Board sends herewith analyses of samples of water collected from different sources near Winchendon during the past year, with a brief statement of the quality of the water from each source, as indicated by the analyses.

The analyses sent included four from upper Naukeag Pond, — Nos. 12095, 12792, 13813, 14122; two from Prentiss meadow, — No. 12188, driven well No. 3, No. 13092, dug well; one from Miller's River, opposite Prentiss meadow, No. 12187; one from Beaman Brook, No. 12094.

These analyses show that the waters of Upper Naukeag Pond and the wells in the Prentiss meadow are soft and of excellent quality for all the purposes of a public water supply.

The waters of Miller's River opposite the wells and of Beaman Brook have a deep brownish color, such as water acquires from contact with vegetable matter in swampy places, contain considerable organic matter, and would not be of satisfactory quality for drinking and some other water supply purposes.

WORCESTER. An application was received Feb. 21, 1895, from the mayor of Worcester, for the advice of the Board relative to the addition of the water of Kettle Brook to the existing water supply of the city. The Board replied to this application as follows: —

BOSTON, March 2, 1895.

The State Board of Health received from you Feb. 21, 1895, an application for its advice relative to the proposed additional water supply for the city of Worcester, to be obtained from Kettle Brook, at or near Kent's Mills, and diverted into the existing Lynde Brook Reservoir, from which the high-service supply of the city is now taken.

The Board has caused examinations of this brook to be made and samples of water from it to be analyzed, and it finds that the water as it now runs in the stream is of fair quality and likely to be as good after storage in the Lynde Brook Reservoir as the water now supplied to the city from that source. The water can be improved, however, by ceasing to use the Arnold Reservoir, which floods a swampy territory near the head of Kettle Brook to a small depth, by draining this swampy territory and by other methods of improving the quality of the water which will suggest themselves to your engineers.

This brook will furnish by gravity a substantial addition to the present supply of your city at a very small cost for engineering works, and the Board regards it as an appropriate source from which to take the next addition to the water supply of your city.

Wrentham (Plainville). An application was received Jan. 8, 1895, from H. G. Bacon and other citizens of Plainville in Wrentham, for the advice of the Board relative to taking the water of Ten Mile River, at some point above Plainville, to which the Board replied as follows: —

Boston, Feb. 5, 1895.

The State Board of Health received from you on Jan. 8, 1895, an application for advice relative to a proposed water supply for a part of the town of Wrentham, in which you state that it is your intention to introduce a system of water supply in the village of Plainville in the town of Wrentham, and, for the purpose of carrying out such a plan, a petition will be presented to the General Court. You ask for advice upon the proposed plan to take the water of Ten Mile River at some point between the village of Plainville and the head of Ten Mile River.

The Board, under date of Dec. 20, 1894, advised the board of water commissioners of the town of North Attleborough with regard to the Ten Mile River above the village of Plainville as a source of water supply for the town of North Attleborough and the village of Plainville. In the communication to North Attleborough (a copy of which is published in the twenty-sixth annual report of the State Board of Health, 1894, page 35), you will find the opinion of the Board with regard to the quality of the water; also its opinion as to the propriety of taking water from this source for the supply for the village of Plainville, as well as for a supply for the town of North Attleborough.

Sewerage and Sewage Disposal.

The following is the substance of the action of the Board during 1895, in reply to applications for advice relative to sewerage and sewage disposal: —

AMESBURY. An application was received from the committee on sewerage of the town of Amesbury Nov. 2, 1894, for the advice of the Board relative to the sewage disposal of Amesbury, having proposed outlets into the Powow River. The Board replied to this application as follows: —

BOSTON, Feb. 12, 1895.

The State Board of Health received from you an application dated Nov. 1, 1894, in which you ask its advice with regard to the disposal of the sewage of Amesbury, and with this application you submit certain plans made several years ago and suggest that they will require some modification.

The Board advises that you have the whole subject re-examined and plans prepared for discharging the sewage into the Merrimack River, and that you adopt a plan for disposing of the sewage in this manner, if it is found practicable to do so. If, however, you find that the cost is too great to warrant the adoption of the complete plan at the present time, it is permissible to discharge temporarily into the Powow River at or below the mouth of Patten's Brook as much sewage as will be furnished by a population of 5,000, but the outlet pipe should be extended to deep water, so as avoid fouling the shores.

ANDOVER. An application, submitting certain specific questions, was received from the sewer commissioners of Andover, Aug. 1, 1895, for the advice of the Board relative to two plans of sewerage and sewage disposal for that town. The Board replied to this application as follows: —

BOSTON, Oct. 10, 1895.

The State Board of Health received from you on Aug. 1, 1895, an application with reference to the disposal of the sewage of the town of Andover, containing the following statement as to your proposed plans: —

"The town of Andover submits two plans for the disposal of its sewage: —

"1. Above the stone bridge, six hundred feet from Main Street, to erect a building, 114 by 42 feet (A), with two sets of double collecting tanks and two filter-beds, thoroughly underdrained, within the building, ventilated through a 4-foot chimney 75 feet high, the effluent to have intermittent filtration out of doors through $2\frac{1}{2}$ acres of prepared filter-beds, underdrained, with 3 feet of sand covered with 3 inches of loam, receiving the sewage from overdrains, the whole draining into the Shawsheen River.

"2. Such a building (B) on the river below Frye Village without out-of-door filter-beds, emptying directly into the Shawsheen River.

"3. Will the Board suggest the size of out-of-door filter-beds deemed necessary to make acceptable our second plant?

"4. Can loam be used over the sand in filter-beds?"

The application was accompanied by plans of the proposed plant at the location first indicated, which is an area of low ground bordering on the right or easterly bank of the Shawsheen River, between Main Street, Harding Street and the Boston & Maine Railroad; and subsequently a report was submitted relating to the proposed method of operation of the plant, and a sample of the sand intended to be used.

The essential features of the plan are settling tanks for the removal of the suspended matters from the sewage by sedimentation; filter-beds having an area of 2,800 square feet, and containing about 5 feet in depth of filtering material, through which it is expected to filter sewage from the settling tanks intermittently at a rate of 3,200,000 gallons per acre daily; and a secondary filter-bed, having an area of 2.3 acres, to be used for the filtration of the effluent from the first-mentioned filters by application to sand beneath a layer of loam. By the alternative plan, the last-mentioned filter-bed may be omitted, but the effluent in either case would be discharged into the Shawsheen River.

The Board has carefully considered the proposed scheme, and finds that it is a thoroughly impracticable one for the disposal of the sewage of the town of Andover.

The settling tanks into which the sewage would be discharged as it came from the main sewer cannot be expected to remove more than a very small portion of the suspended matter. Experiments at Lawrence with reference to the removal of organic matter from sewage by sedimentation have shown that by allowing sewage to settle for four hours about 18 per cent. of the organic matter, as indicated by the albuminoid ammonia, was removed. The consumption of water in Andover for the year 1894 averaged 323,000 gallons per day, and it is not unreasonable to expect that the amount of sewage to be disposed of after the sewerage system has come into general use may be in the vicinity of 200,000 gallons per day. With this quantity of sewage flowing, the time occupied by it in passing through the proposed settling tanks would not average more than two hours, or about one-half the time allowed in the experiments at Lawrence, and during the portion of the day when the flow was greatest the sewage would pass through the tanks in less time; moreover, there would be a constant flow of sewage through the proposed tanks, while in the case of the experiments at Lawrence the liquid was not disturbed.

The in-door filter-beds for the rapid filtration of the sewage after it has passed through the settling tanks are altogether inadequate for the purpose, and would very quickly become clogged, so that the required quantity of sewage could not be made to pass through them.

The proposed rate of filtration for these filters (3,200,000 gallons per acre per day) very greatly exceeds the highest rate ever attained in the filtration of sewage through any sand or gravel in the experiments at Lawrence with the most favorable conditions, even with sewage from which the greater portion of the organic matter had previously been removed; and it may be added that it exceeds even the rate at which Merrimack River water is filtered through the Lawrence city filter.

The effect of applying sewage to the proposed filter at such an excessive rate would be that no opportunity would be allowed for nitrification to become established in the filter, whereby the organic matters would be converted into mineral matters and pass out in the effluent, and the organic matters would consequently accumulate in the interstices of the sand and clog the filter, even if its surface was continually disturbed or scraped.

The purification of sewage by intermittent filtration is not merely mechanical; that is, it is not a straining through fine pores, thereby holding back the organic matters in the sewage, but it is a chemical change, in which the substances are converted into mineral matter, which passes off daily in the purified liquid. To effect this change the experiments at Lawrence have clearly shown that the necessary conditions are very slow motion of very thin films of liquid over the surface of particles having spaces between them sufficient to allow air to be in contact with the films of liquid. With these conditions it is essential that certain bacteria should be present to aid in the process of nitrification; and it has been found that these bacteria come in the sewage at all seasons of the year, and the conditions mentioned appear to be the most favorable for their efficient action.

The proposed filtration area outside the building, to which sewage is to be applied by carriers laid beneath a surface layer of loam, would, on account of the limited capacity of the proposed in-door filters for purifying sewage, receive sewage from which only a small proportion of the organic matter had been removed. While no special chemical or biological difficulties attend the purification of sewage by this form of filter, it has been found both by experiment and in practice that the carriers become clogged with organic matter so that it is necessary to dig up, clean and replace them from time to time, making the cost of maintenance of such a filter greater than where no loam layer is used and sewage is applied directly to the surface of the sand; moreover, experiments with two filters containing the same kind of sand, at Lawrence, to one of which sewage was applied upon the exposed surface of the sand and to the other beneath a layer of loam, it was found that the amount of sewage that could be disposed of by the former was more than twice as great as by the latter.

Finally, if sewage should be filtered through properly prepared beds of sand, such as are proposed for use in the filters under consideration, at a rate which will not overtax the capacity of the filter, the effluent would be

sufficiently purified to permit of its discharge directly into the Shawsheen River without further treatment. It may be added that an area of about six acres of such filter-beds would be sufficient for the town in the beginning, but it would be desirable to provide for increasing the area when necessary.

BROCKTON. An application was received Aug. 16, 1895, from the mayor of Brockton, for the advice of the Board relative to a proposed plan of "surface drainage" in the Cabot Street section of that city. The Board replied to this application as follows: —

BOSTON, Oct. 3, 1895.

The State Board of Health has carefully considered the plan for proposed drainage of the Cabot Street system which you presented for its approval August 5, under the provisions of chapter 309 of the Acts of 1888, and hereby approves said drainage system.

DANVERS. An application was received Nov. 4, 1895, from the board of health of the town of Danvers, for the advice of the Board relative to the disposal of the sewage of certain morocco factories now discharging into Crane's River in that town by conveying it to an outlet at Danversport. The Board replied to this application as follows: —

BOSTON, Dec. 5, 1895.

The State Board of Health has carefully considered your application for advice with reference to disposing of the nuisance in Crane's River caused by the discharge into it of manufacturing sewage from three morocco shops. The plan accompanying your application is to divert the sewage from the brook into which it flows at present, and convey it by means of a sewer to a point of discharge in the channel of the Essex Branch River, a tidal stream, near its junction with Crane's River, and you express a doubt as to whether this method of disposal would be satisfactory.

The proposed outlet is close to the village of Danversport, and it appears that there are very extensive flats in the vicinity, which are exposed at low tide. An analysis of a sample of the sewage, collected as it flowed from the present settling tank, shows that the sewage contains several times as much organic matter as is found in ordinary town sewage, and that a large proportion of it is in suspension. With the conditions existing in the vicinity of the proposed outlet, it is probable that organic matter from the sewage would collect on the flats, and cause a nuisance similar to that now existing in Crane's River. The Board does not, therefore, advise the adoption of this method of disposing of the sewage, and it may be added that there appears to be no body of water in the immediate vicinity of the town into which the sewage could be discharged without offence.

It is probable that the sewage from the establishments in question might be disposed of in connection with a general system of sewerage and sewage disposal for the thickly settled portion of the town; and it is suggested that, when a demand arises for such a system, as will doubtless be the case should the town continue to increase in population, it may be found most economical and otherwise satisfactory to dispose of the sewage in connection with a general system of sewage disposal for the city of Salem and the town of Peabody, for which, as you are aware, the State Board of Health is now making investigations.

It is understood, however, that no system of sewerage is at present contemplated by the town, and under the circumstances it becomes important to determine whether it is feasible to purify this sewage to such a degree that it may be discharged into the stream without causing offence. It could probably be done by conducting the sewage into large settling tanks, where the sludge would settle and the liquid could be pumped to a sand and gravel bed and be filtered, and the sludge be frequently removed from the tanks. The Board cannot with present information advise you definitely with regard to this method of disposal, but will assist you in making an investigation of it, if you desire.

FAIRHAVEN. The selectmen of Fairhaven applied to the Board Feb. 16, 1895, for its advice relative to the best practicable method of disposing of the sewage of the village of Fairhaven, submitting a plan for its disposal by one outlet into tide-water at the end of Union wharf. The Board replied to this application as follows: —

BOSTON, June 7, 1895.

The plan provides for a system of gravity pipe sewers for collecting the sewage at four points, at each of which Shone ejectors are to be placed, to force the sewage to the outlet above mentioned.

The Board, on May 5, 1891, in reply to a previous application, approved this outlet for the discharge of the sewage of certain public buildings and a limited portion of the town, but regards it as an unsatisfactory outlet for the larger quantity of sewage which would be brought to this point by the present plan; and you are, therefore, advised to modify the plan so that the sewage will be carried farther out toward the channel, where it will not foul the docks or shores. It seems probable that this may be done and a satisfactory outlet secured, without excessive cost, by laying a submerged pipe out from the shore at some point not farther north than the southerly end of Crow Island.

FRAMINGHAM. The sewer committee of Framingham applied to the Board Dec. 24, 1894, for its approval, under the provisions of

chapter 403 of the Acts of 1887, of the method of disposal of the water of the under-drain of the main sewers of that town. The Board replied to this application as follows: —

Boston, Feb. 20, 1895.

The Board has considered your application, dated Dec. 24, 1894, in which you ask for its approval of the disposal of the water of the under-drain beneath the Framingham sewers by pumping it to filter-beds located near the present pumping station, as shown on a plan submitted with the application.

A plan for the disposal of this water was presented to the Board Jan. 23, 1893, which provided for diverting it entirely from the water-shed of the Boston water supply by pumping it over the divide into Bannister Brook. Concerning that plan the Board advised that it was a permissible method of disposing of the water, but that filtration might be necessary if the character of the water should deteriorate.

The plan now proposed provides for the disposal of the water of the under-drain by filtration on land within the water-shed of the Boston water supply, and has the advantage of saving to this supply a quantity of water which under the former plan would be lost; but it has the disadvantage that the nitrates in the filtered water will have a slight tendency to promote the growth in Cochituate Lake of the organisms which impart to water disagreeable tastes and odors.

In view of all the circumstances, the Board is of the opinion that the disposal of the under-drain water by the proposed plan is not objectionable from a sanitary point of view, and is an appropriate method of disposing of this water.

Samples of earth sent in by you from three test pits dug in the proposed area have been examined, and the samples from two of them have been found to be of satisfactory quality, except near the surface, for filtration purposes, but samples from the remaining pit consisted of very fine material. In constructing the filter-beds care should be taken to locate them where the material is porous and suitable for filtration. The plan provides for the preparation of an area of about one acre, but it would be desirable to make provision for extending this area in the future if it should be found necessary.

Springfield. The mayor of Springfield applied to the Board Aug. 23, 1895, for advice relative to the extension of certain sewers to the Connecticut River, and the construction of new sewers having their proposed outlets in the river. The Board replied to this application as follows: —

BOSTON, Oct. 3, 1895.

The State Board of Health received from you on Aug. 23, 1895, an application for its advice relative to the proposed extension to the river channel of the sewer outlets in Worthington and Union streets, which now discharge at the bank of the river, and the construction of a new sewer in Longhill street, accompanied by plans showing details of the proposed extensions and the results of float experiments made to determine the direction of currents in the river opposite the city.

The discharge of sewage at the bank of the river has caused a serious fouling of the shores, so that at times of low water they are very offensive. The proposed extensions will carry the sewage away from the river bank well out into the stream, and the points of discharge indicated appear to be so located that the sewage will have passed the city and become well diluted before returning to the shores, and their adoption is recommended. It would, however, be well to avoid the up-turning of the discharge pipe at the end, and have a free outlet, with no depressed portion of the pipe in which solids from the sewage may be deposited.

TEWKSBURY. An application was received from the board of health of Tewksbury, April 9, 1895, for advice relative to the disposal of the sewage of a portion of that town into the Concord River. The Board replied as follows: —

BOSTON, Oct. 3, 1895.

The State Board of Health received from you on April 9, 1895, an application with reference to a partial system of sewerage in the portion of Tewksbury bordering on the Concord River, accompanied by a profile showing a proposed sewer in Whitehead and Warnock streets, ending in the Concord River, near the boundary between the town of Tewksbury and the city of Lowell.

The Board has caused an investigation of the proposed plan to be made, and has deemed it necessary, in view of the existing conditions, to take into consideration the whole subject of sewerage and sewage disposal for the rapidly growing portion of the town near to Lowell. Aside from the locality to be drained by the proposed sewer, there are other localities in this part of the town, containing a much larger population, which appear to be already in need of sewerage facilities, or, with a continued rapid increase in population, likely to need them in the near future.

While the discharge of sewage from the proposed sewer, under present conditions, into the Concord River, might not cause any serious harm, the Board is of the opinion that no large amount of sewage can safely be disposed of in this way, owing to the conditions that prevail in the vicinity of the river below, where there are densely populated sections of the city of

Lowell in the immediate vicinity of the stream. It is also worthy of note that the city of Lowell has been compelled by the courts to discontinue the discharge of sewage into the Concord River, above the last dam.

In view of all the circumstances, the Board advises that a more extended investigation be made of the subject of sewerage and sewage disposal for this rapidly growing portion of the town of Tewksbury, both in order that sewers may be constructed in the beginning in accordance with some well-defined plan for the district as a whole, and in order that a suitable method of disposing of the sewage be adopted in the beginning.

It is suggested that, in connection with investigations of methods of disposing of the sewage of this portion of the town, there appear to be two feasible methods which are worthy of investigation, — one by disposal on filter-beds of sufficient area, as at Framingham, Marlborough and several places in the State, and the other by disposal in connection with the sewerage system of the city of Lowell.

The Board will advise you further in this matter when you have additional information to present.

WEBSTER. The sewer commissioners of Webster applied to the Board Oct. 15, 1895, for its advice relative to a proposed system of sewerage and sewage disposal for that town, having its outlet into French's River, at a point below the bridge of the Southbridge branch of the New England Railroad. The Board replied to this application as follows: —

BOSTON, Jan. 3, 1896.

From investigations made by the Board, through its engineers, it appears that French's River is already considerably polluted by manufacturing sewage. Below the proposed sewer outlet there are several millponds which afford a favorable opportunity for the solid portions of the sewage and manufacturing wastes to settle and become offensive. Near each of these millponds is a village, the inhabitants of which would necessarily be affected by the pollution of the river and the deposits of organic matter on the bottoms and sides of the ponds.

Under the circumstances, the Board does not advise the disposal of the sewage of Webster as proposed, by discharging it without treatment into French's River, but advises a further investigation of the subject of sewage disposal, with a view to purifying the sewage in such a manner that the effluent may subsequently be discharged into the river without danger of causing offence to the inhabitants of the villages on the river below.

A tract of land is referred to in the report of your engineer in connection with the disposal of the sewage by filtration or irrigation. The Board would advise a thorough investigation of the areas suitable for the dis-

posal of sewage in the vicinity of the river below the proposed outfall, to determine the location and extent of the areas available for sewage filtration.

The Board will advise you further in this matter when you have additional information to present.

STATE FARM AT BRIDGEWATER. An application was received from the superintendent of the State Farm at Bridgewater for the advice of the Board relative to the disposal of the sewage of that institution. The Board replied as follows: —

BOSTON, Dec. 14, 1895.

The State Board of Health has carefully considered your application for advice as to the disposal of the sewage of the State Farm, and has caused an examination of the territory in the vicinity of the farm to be made by its engineers.

The present method of disposing of the sewage after leaving the buildings is to convey it to settling tanks just outside the northwesterly corner of the grounds of the institution, from which it is allowed to overflow and run down the hill into a small brook, which is very badly polluted thereby, and thence into the Taunton River.

While you have a large area of land upon which sewage might be used for irrigation, and some advantages to the crops be obtained thereby, the material is not favorable to absorbing a large amount of the sewage, and it would have to be applied with a good deal of care to prevent its becoming offensive.

North of the institution, beyond the brook and about a mile and a quarter from the buildings, you have some land which appears to be adapted to filtration; and the Board would advise that you cause an examination to be made, to determine whether this area is available for the disposal of the sewage of the institution at a reasonable expense, and whether the area of suitable porous material is of sufficient extent to filter all of the sewage of the institution, and produce an effluent that may be discharged into the stream without objection.

POLLUTION OF INLAND WATERS.

THE BLACKSTONE RIVER. An application was received Aug. 17, 1895, from the selectmen of Millbury, asking the advice of the Board "in reference to the pollution of the Blackstone River by the sewage and by the effluent from the sewage precipitation works

of the city of Worcester," and at the same time asking the opinion of the Board "whether the city of Worcester is at the present time so treating its sewage that it does not produce a nuisance in the river, in conformity with the act of 1886 (chapter 331), and whether the nuisance now existing is due, and solely due, to the deposits formed in the river prior to the 25th of June, 1890." The Board replied to this application as follows: —

BOSTON, Dec. 7, 1895.

In 1891 the board of health of Millbury submitted to this Board certain questions relating to this subject, and in a reply dated March 1, 1892, the Board expressed its opinion as to the condition of the river where it enters the town of Millbury at that time, as compared with its condition in 1886, when the act which established a system of sewage disposal for the city of Worcester was passed, as follows: —

"The population of Worcester from 1885 to 1890 increased twenty-four per cent., and the increase from 1886 to 1891 would not be materially different. The sewage of the city of Worcester is turned into Mill Brook, and mingles with the natural water of the brook. A portion of this mingled sewage and brook water is then diverted to the disposal works. Judging from the flow which may naturally be expected in a brook draining an area of the size drained by Mill Brook, and from such information as is now available to the Board with regard to the amount of sewage treated at the disposal works, it seems probable that the percentage of sewage treated will no more than offset the increase in population from 1886 to 1891. If we take into account that the total length of sewers in Worcester has increased much faster than the population, and that all of the organic matter is not removed from the sewage by the process of precipitation, there can be no doubt that the amount of organic matter discharged into the river from Worcester is greater at the present time than it was in 1886.

"The examination of the water of the river, where it enters the town of Millbury, made by the Board, indicates that it is seriously and offensively polluted by sewage; and by comparing the analyses of the water, which have been made monthly by the Board since June, 1887, it appears that the pollution of the river was no less during the past year than it was in the years before the Worcester sewage disposal works were put in operation."

Since the last reply of the Board was made, the city of Worcester has greatly increased the capacity of its sewage precipitation works, the enlarged works being first operated in July, 1893; and it appears from the report of the superintendent of sewers that the amount of sewage drawn from Mill Brook and treated at the precipitation works in the year ending Nov. 30,

1894, averaged about 12,500,000 gallons per day, and that a portion of the sewage at times of high flow in the brook escapes into the river without treatment.

The population of the city of Worcester has increased since 1886 about thirty-nine per cent., and the total length of sewers has increased during that time about eighty-seven per cent., from which it would be reasonable to conclude that the amount of sewage discharged by the sewers has doubled. It appears from the report of the superintendent of sewers that, on an average, about fifty per cent. of the organic matter is removed from the sewage by treatment at the precipitation works; and, taking into consideration the fact that a portion of the sewage escapes into the river without treatment, it would be expected that the amount of organic matter discharged into the river in the sewage and effluent of the city of Worcester is as great as in 1886.

As a means of determining the condition of the river from time to time, the Board has continued its regular examination; and, in order to compare the condition of the river in 1895 with that existing before the last reply was made, the Board has caused a special examination of the river to be made by means of numerous chemical analyses of samples collected at various points and at frequent intervals during the week ending Sept. 11, 1895, corresponding to an examination made in the week ending July 29, 1891. From the results of these investigations the Board finds that the condition of the river below the point of discharge of the effluent from the precipitation works and in the town of Millbury is practically the same as it was at the time when the last reply was made.

The Worcester precipitation works have been conducted under the direction of skilled engineers and chemists, and the percentage of organic matter removed from the sewage treated at the works, even on the scale required, has doubtless been as great as it is practicable to attain by chemical precipitation alone. As the city grows and the amount of sewage increases, the amount of organic matter discharged into the river will also necessarily increase, unless a more complete purification of the sewage is made.

Lake Quinsigamond. The selectmen of Shrewsbury called the attention of the Board July 1, 1895, to the possible pollution of Lake Quinsigamond (which lies partly in Shrewsbury) by the sewage of the Worcester Lunatic Hospital. The Board replied to this communication as follows: —

Boston, Dec. 5, 1895.

The State Board of Health has considered your application with reference to the pollution of Lake Quinsigamond by the sewage from the

Worcester Lunatic Hospital, and has caused an examination of the premises to be made.

From present information the Board is not prepared to give an opinion in this matter, but will cause a further investigation to be made during the coming year, and will then inform you as to its conclusions.

LAKE CHAUNCY. The following communication was received from the selectmen of Northborough Sept. 17, 1895:—

NORTHBOROUGH, MASS., Sept. 17, 1895.

GENTLEMEN:—For a number of months the sewage of the Westborough Insane Hospital has been discharged directly and without treatment into Lake Chauncy, one of the great ponds of the State, and within the limits of this town.

We respectfully ask you to examine the premises, and if, in your opinion, the conditions are prejudicial to health or comfort, to take such action as may be necessary.

Respectfully,

(Signed) CYRUS H. MENTZER,
EDWIN S. COREY,
JAMES S. LEARNED,
Selectmen of Northborough.

In consequence of this letter the following communication was sent to the trustees of the Westborough Lunatic Hospital, and a copy of the same was also sent to the selectmen of Northborough:—

BOSTON, Dec. 5, 1895.

Information has been received from the selectmen of Northborough that for a number of months the sewage of the Westborough Insane Hospital has been discharged directly and without treatment into Little Chauncy Pond. The investigations made by the Board, through one of its engineers, show that such is the case, and that there is strong evidence that this condition has existed for a considerable time.

This method of disposal of the sewage causes the serious pollution of Little Chauncy Pond and the stream flowing from it through Northborough into the Assabet River, and is a menace to the public health. It is not, in any sense, a proper method of disposing of the sewage from this institution, and should not be allowed to continue.

In 1887 the trustees of the hospital requested the Board to examine the sewerage system of the hospital and recommend a proper method of disposal. After careful examination of the premises by the engineer of the

Board, a reply was made to the effect that the most suitable method of disposal was upon land situated on the opposite side of the brook leading from Chauncy Pond to Little Chauncy Pond.

A few months later a general plan for a system of subsurface disposal was presented by you through your engineer, which provided for disposal upon a tract of land upon the side hill north-westerly from the hospital. From inspection of the area upon which it was proposed to dispose of the sewage, it did not appear to the Board that it was adapted to the purpose; but after giving a hearing, at which your engineer explained the nature of the ground on which it was proposed to dispose of the sewage, and the general features of the plan, it appeared from his account that the material, as shown by the trial pits, proved to be so much better adapted to the filtration of sewage than inspection of its surface promised, that the committee on water supply and sewerage of the Board saw no reason to doubt that the sewage of the hospital could be disposed of upon it without risk to the health of the inmates or the public. Your engineer declined to explain the details of the method of distribution, and the Board expressed no opinion upon this subject.

Since it now appears that the sewage is not purified by this method, and it is very improbable that with such soil as that of which the field is composed the sewage could be properly disposed of under the most favorable circumstances by subsurface irrigation, the Board advises that you convey the sewage across the brook, and dispose of it by filtration upon the tract of land which investigation has shown to be available, in general accordance with the advice of the Board contained in the communication addressed to you May 9, 1887, previous to the adoption of the present system.

The Board will, on application, advise you further as to the details of a plan for the satisfactory disposal of the sewage, if you desire it.

Examination of Water Supplies.

EXAMINATION OF WATER SUPPLIES.

EXPLANATORY NOTE.

The systematic examination of the water supplies of the State was begun June 1, 1887, and has been continued up to the present time. The results of the investigations made during the first two years were published in a special report of the Board upon the Examination of Water Supplies (1890), and of those made during succeeding years in the annual reports of the Board beginning with the 1890 (Twenty-second Annual) report.

The special report contains a description of each of the water supplies in the State existing at the date of that report, and the annual reports contain descriptions of new works and changes in existing works.

In all of these reports an alphabetical arrangement by towns has been adopted. Sources of water supply are tabulated under the name of the town supplied, other waters under the name of the town in which they are situated. The analyses of water from the larger rivers not used as sources of water supply are given in a subsequent tabulation, headed "Examination of Rivers."

The method of making the chemical examinations remains unchanged, and the results are presented in the tables of this report in the same form as in the last one.

The samples of water are usually received at the laboratory from twenty-four to forty-eight hours after collection. All surface water and such samples of ground water as contain suspended matter are filtered through filter-paper before determining the color, the residue on evaporation and the albuminoid ammonia in solution. Some ground waters which are perfectly clear and colorless when drawn from the ground become turbid and colored on standing, in consequence of the oxidation of the iron which they contain. In these waters the residue on evaporation is determined without filtration, since this iron is an essential and not an accidental ingredient in the water. In the changes which accompany the oxidation of the iron in waters of this character, they become first cloudy (well described by the word *milky*) and finally deposit a precipitate of oxide of iron. In the cloudy condition they have a distinct color, which while it does not have the same significance as in the case of surface waters, and is only a passing phenomenon, is, nevertheless, of interest as showing a color which the water may assume while the oxidation of the iron is in progress. When the iron is all oxidized and precipitated the water may become colorless again. Explanatory notes will be given for waters of this kind in connection with the tables of analyses.

The color of water is expressed by numbers which increase with the amount of color. The standard used is nesslerized ammonia, as described on page 531 of the Special Report upon the Examination of Water Supplies, 1890, and on page 329 of the Annual Report for 1892. Boston water, as drawn from a tap at the Institute of Technology, had an average color in 1895 of 0.72. Other water supplies in the State have had an average color of from 0 to 1.30.

In cases where examinations of a source have been made with considerable regularity for several years, the averages of the chemical analyses of each year are given.

There was no change in the method employed in the microscopical examination of water between Nov 6, 1890, and Dec. 1, 1895. The method employed between those dates is fully described in the Twenty-third Annual Report of the Board for the year 1891 (pages 395–421). Before Nov. 6, 1890, the methods employed were less perfect, so that a smaller proportion of the total number of organisms present in the water was separated from it and observed under the microscope; and, before drawing conclusions from a comparison of the microscopical examinations of waters made before and after this date, the explanatory note on page 70 of the Twenty-second Annual Report for 1890 should be read.

Since Dec. 1, 1895, the method for the microscopical analysis of water has been considerably improved by discarding the ordinary glass funnels previously employed and substituting funnels which have been constructed with stems of eqnal calibre, to give equal rates of filtration, and with steeper sides, so that those organisms which are of a gelatinous character will be less liable to adhere to the sides of the funnel. By the use of these funnels variations in the numbers of organisms found, which may be caused by dissimilar slopes of the sides of the funnels and unequal rates of filtration, are avoided.

To indicate the amount of the so-called *Zoöglœa* observed, the number of individual masses is not counted, but an area equal to 2,500 square microns, or .0025 square millimeters, has been adopted as an arbitrary unit.

In publishing the results of the microscopical examinations the same system is followed as last year. The plants observed are classified in four groups, viz.: Diatomaceæ, Cyanophyceæ, Algæ and Fungi. The animals observed are grouped as Rhizopoda, Infusoria, Vermes and Crustacea.

The names of the different genera in each group are given with the numbers of each per cubic centimeter, except that, to avoid making the tables excessively long, they are omitted when present only in very small numbers. It is not feasible to make with regard to omissions a single rule which will apply to all cases, because it is desirable to include smaller numbers of animals than of plants, and of the larger animals than of animals generally. Moreover there are exceptional cases in which it is desirable to indicate the presence of even very small numbers of the more important plants or animals. Two general rules, however, have been adopted in printing the results, viz.: —

1. All genera of plants are included in which the total number observed in twelve months amounts to 6 or more per cubic centimeter, or, in other words, averages as much as 0 5 per month.

2. All genera of animals are included in which the total number observed in twelve months amounts to 1.5 or more per cubic centimeter.

The larger microscopic animals, such as some of the Crustacea, are included, even when present only in very small numbers.

Fractions are generally omitted from the table, the nearest whole number of organisms per cubic centimeter being given. Where the total number of organisms observed is 0.5 or less, the fact that the organism was present is usually indicated by the abbreviation "pr.," but in the case of the larger organisms very small fractions are given.

EXAMINATION OF WATER SUPPLIES.

WATER SUPPLY OF ABINGTON AND ROCKLAND.

Chemical Examination of Water from Big Sandy Pond, Pembroke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13793	Feb. 10	V. slight.	Slight.	.20	3.15	0.90	.0036	.0182	.0162	.0020	.70	.0000	.0000	.2800	1.1
13961	Mar. 11	V. slight.	Slight.	.10	3.05	0.70	.0004	.0146	.0126	.0020	.65	.0050	.0000	.2310	0.6
14133	Apr. 11	Distinct.	Slight.	.10	2.70	1.10	.0000	.0168	.0164	.0004	.64	.0000	.0000	.2926	0.5
Av.	....	....	....	.13	2.97	0.90	.0013	.0165	.0151	.0014	.66	.0017	.0000	.2679	0.7

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Free Ammonia.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1887*	-	-	.20	3.45	0.94	.0008	.0150	-	-	.58	.0056	-	-	-
-	1888†	-	-	.10	3.23	0.82	.0006	.0164	-	-	.55	.0073	.0001	-	-
-	1892‡	-	-	.10	4.30	-	.0000	.0200	.0150	.0050	.59	.0090	.0000	-	0.5
-	1893	-	-	.07	3.19	1.19	.0010	.0146	.0122	.0024	.63	.0012	.0000	.2130	0.5
-	1894§	-	-	.04	2.75	1.00	.0003	.0131	.0109	.0022	.62	.0050	.0000	.1730	0.2
-	1895‖	-	-	.13	2.97	0.90	.0013	.0165	.0151	.0014	.66	.0017	.0000	.2679	0.7

* June to October, six samples. † January to April, five samples. ‡ March.
§ March and April. ‖ February, March and April.

NOTE to analyses of 1895: Odor of the first sample distinctly vegetable, becoming unpleasant on heating; of the second, faintly aromatic, becoming distinctly vegetable and unpleasant on heating; of the third, very faint or none, becoming faintly vegetable on heating.——The samples were collected from a faucet at the pumping station.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each sample was as follows: No. 13793, 64; No. 13961, 88; No. 14133, 717, consisting chiefly of *Dinobryon* and *Synedra*.

Acton.

Chemical Examination of Water from Tubular Test Wells in Acton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14797	Aug. 10	Slight, clayey.	Heavy, sandy.	.02	5.80	.0004	.0004	.22	.0100	.0000	.0624	2.6	.0050
14798	Aug. 10	Distinct, clayey.	Heavy, sandy.	.04	5.50	.0002	.0000	.22	.0040	.0000	.0783	2.6	.0100
15166	Sept. 13	Decided, clayey.	Cons., earthy.	.04	6.70	.0000	.0010	.22	.0030	.0000	.0406	2.6	.0370

Odor, none. —— The samples were collected from tubular test wells in Acton, which were located approximately as follows: No 14797, 250 feet east of the town line between Acton and Boxborough and about 350 feet north of Massachusetts Avenue. No 14798, about 340 feet east of the same boundary line and 500 feet north of Massachusetts Avenue. No. 15166, about 35 feet east of the boundary line and 280 feet north of Massachusetts Avenue. The analyses were made in connection with an investigation for a water supply for the town of Acton.

Microscopical Examination.

No organisms.

Chemical Examination of Water from Fort Pond, Littleton, and Magog Brook and Magog Pond, Acton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
15784	Dec. 20	V. slight.	V. slight	.30	3.10	1.20	.0046	.0170	.0136	.0034	.23	.0100	.0001	.3311	0.5
15785	Dec. 20	V. slight.	Cons.	.57	3.30	1.55	.0004	.0170	.0126	.0044	.22	.0100	.0000	.5390	0.5
15786	Dec. 20	V. slight.	Slight.	.10	2.45	1.30	.0028	.0332	.0296	.0036	.30	.0000	.0000	.2141	0.3

Odor, none; on heating, the first two samples had a faintly vegetable odor. —— The samples were collected as follows: No. 15784, from Fort Pond, about 30 feet from the shore at the southerly end; No. 15785, from Magog Brook, about 50 feet above the road leading from Acton Centre to North Acton and about one mile below Magog Pond; No. 15786, from Magog Pond, near the road at the easterly end.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 15784, 123; No. 15785, 43; No. 15786, 41.

Water Supply of Adams Fire District, Adams.

The advice of the State Board of Health to the Adams Fire District with reference to an additional supply of water may be found on pages 10–13 of this volume.

The present sources of supply are Bassett and Dry brooks, on each of which there is a small reservoir. An auxiliary supply is obtained from a well of the Renfrew Manufacturing Company in the village, and during the drier portion of 1895 a small additional quantity of water is said to have been pumped from tubular wells at the Zylonite Works in the northerly portion of the village.

The results of analyses of samples of water from these sources and from other sources investigated with reference to an additional water supply for the Fire District are given in the following tables.

Chemical Examination of Water from Bassett Brook, Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14181	Apr. 17	None.	Slight.	.05	2.70	1.00	.0000	.0048	.0042	.0006	.07	.0600	.0000	.1698	1.1
15083	Sept. 8	None.	V slight.	.08	6.40	0.00	.0000	.0014	-	-	.10	.0110	-	-	3.2
15158	Sept. 11	Slight.	Slight.	.07	7.20	0.00	.0000	.0042	.0038	.0004	.12	.0130	.0000	.1092	5.0

Odor, none. —— The first sample was collected from a tap in the town and represents water from Bassett Brook; the second, from Bassett Brook just above the reservoir; the third, from the reservoir.

Microscopical Examination.

No. 15083 was not examined. An insignificant number of organisms was found in the other samples.

ADAMS.

Chemical Examination of Water from Dry Brook in Adams and Cheshire.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14180	Apr. 17	Slight.	Cons., earthy.	.35	3.40	1.70	.0004	.0100	.0084	.0016	.06	.0050	.0000	.5214	1.6
14302	May 14	V. slight.	Slight.	.65	4.55	2.00	.0008	.0164	.0150	.0014	.04	.0040	.0000	.7386	2.2
14303	May 14	V. slight.	Slight.	.35	6.30	1.90	.0004	.0116	.0088	.0028	.06	.0020	.0000	.4858	3.6
15085	Sept. 7	None.	V. slight.	.10	11.50	0.30	.0000	.0068	-	-	.17	.0090	-	-	9.4
15159	Sept. 11	Slight.	Slight.	.08	11.50	0.40	.0000	.0086	.0058	.0028	.10	.0050	.0000	.1872	8.4

Odor, very faint or none.——No. 14180 was collected from the brook about 2 miles above the reservoir; No. 14302 just below the road crossing above the sand mill and 2.5 miles above the reservoir; Nos. 14303 and 15159 from the reservoir; No. 15085 from the brook just above the reservoir.

Microscopical Examination.

No. 15085 was not examined. An insignificant number of organisms was found in each of the other samples.

Chemical Examination of Water from the Well of the Renfrew Manufacturing Company, Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14216	Apr. 29	None.	V. slight.	.00	14.70	.0000	.0006	.18	.1000	.0000	.0038	12.3	.0000
15086	Sept. 7	None.	None.	.00	15.80	.0000	.0000	.13	.0500	-	-	12.6	.0070

Odor, none.——The samples were collected from a faucet at the pumping station.

Microscopical Examination.

No. 14216. No organisms.
No. 15086. Not examined.

ADAMS.

Chemical Examination of Water from a Tubular Well at the Zylonite Works in the Northerly Portion of the Village of Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14182	1895. Apr. 17	None.	None.	.00	13.80	.0000	.0000	.10	.0500	.0000	.0197	11.9	.0020

Odor, none. —— The sample was collected from one of the wells which was flowing at the time.

Microscopical Examination.

No organisms.

Chemical Examination of Water from South Brook in Cheshire.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14179	Apr. 17	V. slight.	Cons., earthy.	.25	3.60	1.65	.0012	.0100	.0090	.0010	.07	.0300	.0000	.4147	1.6
15084	Sept. 7	None.	V. slight.	.18	4.70	0.50	.0004	.0048	-	-	.13	.0110	-	-	3.2

Odor, very faintly vegetable. —— The first sample was collected from the brook below the sand mill, about 0.3 of a mile from the point where the brook joins the Hoosac River; the second, from the brook above the sand mill, about a mile from the point where the brook joins the river.

Microscopical Examination.

No. 14179. An insignificant number of organisms was found in this sample.
No. 15084 was not examined.

ADAMS.

Chemical Examination of Water from Tophet Brook in Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14188	Apr. 17	-	-	.27	-	-	-	-	-	-	.10	-	-	-	1.4
15071	Sept. 7	None.	V. slight.	.03	8.70	0.00	.0000	.0046	.0034	.0012	.15	.0020	.0002	.1131	7.6

Odor of the first sample, not determined; of the second, very faintly vegetable, becoming somewhat stronger and mouldy on heating.——The samples were collected from the brook, at a road crossing about 1.25 miles above its mouth.

Microscopical Examination.

No. 14188. Not examined.
No. 15071. An insignificant number of organisms was found in this sample.

Chemical Examination of Water from the Hoosac River and from Fisk and Anthony Brooks in Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14304	May 14	Decided.	Slight.	.20	6.85	1.45	.0000	.0150	.0110	.0040	.06	.0080	.0000	.2686	5.1
14521	June 20	Distinct.	Cons.	.23	8.60	1.75	.0014	.0220	.0184	.0036	.08	.0050	.0001	.4019	6.7
14386	May 29	None.	Slight.	.07	9.50	1.80	.0000	.0038	.0032	.0006	.08	.0280	.0000	.1026	6.7
14387	May 29	None.	Slight.	.12	4.30	1.60	.0002	.0068	.0054	.0014	.10	.0050	.0000	.1938	2.5

Odor of the first two samples, distinct; of the others, none.——The first two samples were collected from the Hoosac River at a railroad crossing just above Cheshire Harbor; the third from Fisk or Dean Brook just below Peck's Falls; the last from Anthony Brook just below the road from Savoy Centre to Adams.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

ADAMS.

Chemical Examination of Water from Various Ground Water Sources in the Vicinity of Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14305	May 14	Decided, clayey.	Cons., earthy.	.20	9.05	.0570	.0220	.10	.0210	.0000	.3041	6.0	.0700
14388	May 29	None.	Cons.	.00	12.30	.0000	.0010	.12	.0500	.0000	.0380	10.0	.0080
14389	May 29	None.	Cons., floccul't.	.00	14.70	.0016	.0038	.09	.0600	.0000	.0228	13.3	.0000
14522	June 20	Distinct, clayey.	Cons., earthy.	.00	12.00	.0004	.0002	.08	.0200	.0000	.0293	10.3	.0000
14523	June 20	None.	V. slight.	.00	12.10	.0002	.0002	.12	.0300	.0000	.0000	10.6	.0080
14554	June 29	Decided, clayey.	Cons., sandy.	.00	17.70	.0000	.0000	.04	.0930	.0000	.0174	14.8	.0100
15072	Sept. 7	None.	Slight, white.	.02	13.00	.0000	.0002	.12	.0400	.0000	.0312	11.0	.0140

Odor of 14389, faintly vegetable and disagreeable, disappearing on heating; of the other samples, none.——The samples were collected as follows: No. 14305 from a test pit 30 feet from the Hoosac River on the west side of the Boston & Albany Railroad, 2,000 feet south of the railroad bridge over the Hoosac River, just above Cheshire Harbor; No. 14388, from the west spring of the Brown Paper Company; No. 14389, from Follett's Spring, opposite Follett's lime works, in the northerly part of Adams; the remaining samples, from test wells in the valley of the Hoosac River, about half a mile above Cheshire Harbor.

Microscopical Examination.

No. 14305. Miscellaneous, *Zoöglœa*, 4,600.
No. 14388. Diatomaceæ, *Synedra*, 1.
No. 14389. Diatomaceæ, *Diatoma*, 1; *Navicula*, 4; *Pinnularia*, 1; *Synedra*, 30. Total, 36.
No organisms were found in the remaining samples.

Water Supply of Amesbury.—Powow Hill Water Company.

The advice of the State Board of Health to the Powow Hill Water Company relative to taking an additional supply of water from the ground near Main Street in that town may be found on pages 13 and 14 of this volume. Analyses of samples of water collected from the present and other sources, in connection with the investigation for an additional supply, are given in the following tables.

AMESBURY.

Chemical Examination of Water from Tubular Wells supplying Open Basins near Main Street.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14242	May 1	Slight.	Slight, green.	.03	9.30	.0004	.0020	.59	.0550	.0000	.0000	3.9	.0100
14849	Aug. 17	Distinct, milky.	Slight.	.12	10.00	.0004	.0024	.60	.0450	.0001	.1326	3.8	.0300

Odor of the first sample, faintly unpleasant, disappearing on heating; of the second sample, none. —— The samples were collected at the pumping station on Main Street.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14242, 164; No. 14849, 363.

Chemical Examination of Water from Thirty-six Tubular Wells near Market Street, and from an Open Distributing Reservoir supplied from these Wells.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
15167	Sept. 14	Slight, milky.	None.	.02	20.70	.0028	.0008	1.02	.0030	.0000	.0140	10.9	.0130
14243	May 4	Slight.	Cons., white.	.04	13.90	.0000	.0182	1.16	.0030	.0000	.2772	8.0	.0010

Odor of the first sample, none; of the last, distinctly unpleasant. —— The first sample was collected at the pumping station on Market Street, and the last from a faucet connected with the upper reservoir and the Market Street station.

Microscopical Examination.

No. 15167, Fungi, *Crenothrix*, 1. Miscellaneous, *Zoöglœa*, 7. Total, 8.

No. 14243, Diatomaceæ, *Asterionella*, 32; *Synedra*, 16,000. Vermes, *Anurea*, 24; *Rotatorian ova*, 1. Total, 16,057.

AMESBURY.

Chemical Examination of Water from a Tubular Test Well in Amesbury.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
13043	**1894.** Sept. 28	None.	None.	.07	8.00	.0030	.0002	.32	.0060	.0000	.0280	3.1	.0030
14241	**1895.** May 1	None.	None.	.00	7.20	.0000	.0000	.33	.0030	.0000	.0000	3.0	.0090

Odor, none. —— The samples were collected from a tubular test well about 2,000 feet south of the pumping station on Main Street.

Microscopical Examination.

No organisms.

Chemical Examination of Water from Kimball's Pond, Amesbury.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
14240	**1895.** May 3	Slight.	Cons.	.58	4.05	1.75	.0014	.0172	.0162	.0010	.38	.0000	.0000	.6399	1.3

Odor, distinctly vegetable and sweetish, becoming stronger on heating. —— This pond is not used as a source of public water supply.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 24; *Cyclotella*, 9; *Cymbella*, 2; *Epithemia*, 1; *Fragilaria*, 13; *Melosira*, 190; *Navicula*, 13; *Pinnularia*, 1; *Synedra*, 153; *Tabellaria*, 10. Algæ, *Closterium*, 1; *Desmidium*, 1; *Protococcus*, 3. Fungi, *Crenothrix*, 4. Rhizopoda, *Actinophrys*, 1. Infusoria, *Dinobryon*, 27; *Dinobryon cases*, 192; *Synura*, 3. Vermes, *Rotifer*, 2. Miscellaneous, *Zoöglœa*, 48. Total, 698.

ANDOVER.

WATER SUPPLY OF ANDOVER.

Chemical Examination of Water from Haggett's Pond, Andover.

[Parts per 100,000]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed	Hardness.
	1895.														
13797	Feb. 11	V. slight.	V. slight.	.15	3.30	0.90	.0018	.0146	.0136	.0010	.35	.0030	.0000	.2920	1.4
13965	Mar. 12	None.	V. slight.	.12	3.40	1.20	.0026	.0142	.0128	.0014	.44	.0050	.0000	.2941	1.6
14103	Apr. 8	V. slight.	V. slight.	.17	3.95	1.45	.0020	.0160	.0136	.0024	.38	.0040	.0000	.3234	1.7
Av..	....	....	....	.15	3.55	1.18	.0021	.0149	.0133	.0016	.39	.0040	.0000	.3032	1.6

Averages by Years.

-	1889*	-	-	.10	5.85	2.70	.0004	.0198	.0170	.0028	.29	.0040	.0001	-	1.1
-	1891†	-	-	.08	3.35	1.70	.0004	.0136	.0080	.0056	.33	.0030	.0000	-	1.3
-	1892	-	-	.06	3.20	1.02	.0003	.0175	.0147	.0028	.34	.0051	.0000	-	1.3
-	1893	-	-	.09	3.30	1.30	.0013	.0151	.0124	.0027	.34	.0020	.0000	.2762	1.2
-	1894‡	-	-	.09	3.34	1.18	.0009	.0122	.0105	.0017	.34	.0020	.0000	.2915	1.3
-	1895§	-	-	.15	3.55	1.18	.0021	.0149	.0133	.0016	.39	.0040	.0000	.3032	1.6

* July. † November. ‡ January to April. § February, March and April.

NOTE to analyses of 1895: Odor, faintly vegetable.—— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 96, consisting chiefly of *Synedra* and *Dinobryon*.

WATER SUPPLY OF ARLINGTON.

Works for the supply of the higher portions of the town were completed in the early part of 1895. The supply is drawn from twenty-five 2½-inch tubular wells located at the edge of the Great Meadows, near the Boston & Maine Railroad, opposite the East Lexington station. The wells have an average depth of about 35 feet. Water is forced from the wells to a covered iron tank, 40 feet in diameter and 60 feet high, situated on Arlington Heights. The capacity of this tank is 565,000 gallons.

ARLINGTON.

The advice of the State Board of Health to the town of Arlington, with reference to this source of water supply, may be found on pages 7 and 8 of the annual report for 1894, and analyses of samples of water collected during the investigations for an additional supply may be found in the annual reports of the Board for 1892 and 1893.

Chemical Examination of Water from Tubular Wells at East Lexington.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14143	Apr. 15	Slight, milky.	V. slight.	.20	9.00	.0094	.0090	.52	.0080	.0000	.1422	5.4	.0870
14902	Aug. 23	Decided, rusty.	Cons., rusty.	.23	11.00	.0084	.0056	.52	.0000	.0002	.1872	5.4	.1600
15400	Oct. 18	Distinct, milky.	Cons., rusty.	.18	10.30	.0114	.0086	.54	.0070	.0000	.2356	5.9	.0800
15673	Dec. 4	V. slight, milky.	None.	.08	9.30	.0094	.0066	.50	.0030	.0000	.1732	5.1	.0560
Av.	....	....	....	.17	9.90	.0097	.0075	.52	.0045	.0001	.1846	5.5	.0958

Odor of the first and last samples, none; of the second, decidedly disagreeable; of the third, distinctly vegetable and sweetish.—— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

No. 14143. Fungi, *Crenothrix*, 9. Miscellaneous, *Zoöglœa*, 40. Total, 49.
No. 14902. Miscellaneous, *Zoöglœa*, 288.
No. 15400. Fungi, *Crenothrix*, 3,600.
No. 15673. Fungi, *Crenothrix*, 1,252.

Chemical Examination of Water from the Storage Reservoir of the Arlington Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14938	Aug. 30	Decided, green.	Cons., green.	.65	7.90	4.70	.0000	.0822	.0382	.0440	.69	.0030	.0002	.7931	2.5

Odor, decidedly vegetable, grassy and mouldy.—— The sample was collected from the reservoir.

Microscopical Examination.

Cyanophyceæ, *Anabæna*, 1,400; *Clathrocystis*, 950; *Cœlosphærium*, 250. Algæ, *Pediastrum*, 50; *Scenedesmus*, 50. Infusoria, *Monas*, 50. Total, 2,750.

ASHBURNHAM.

Chemical Examination of Water from Upper Naukeag Pond, Ashburnham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13813	Feb. 12	None.	V. slight.	.10	1.70	0.85	.0020	.0136	.0122	.0014	.12	.0030	.0000	.2080	0.2
14122	Apr. 9	V. slight.	Slight.	.10	1.50	0.35	.0008	.0098	.0086	.0012	.12	.0050	.0000	.2579	0.0
14681	July 23	V. slight.	Slight.	.08	1.60	0.90	.0008	.0100	.0086	.0014	.13	.0020	.0000	.1875	0.3
14801	Aug. 12	V. slight.	Slight.	.05	2.10	1.25	.0006	.0110	.0094	.0016	.14	.0040	.0000	.2262	0.5
Av.	....	....	....	.08	1.72	0.84	.0011	.0111	.0097	.0014	.13	.0035	.0000	.2199	0.3

Averages by Years.

-	1888	-	-	.13	2.01	0.60	.0002	.0145	-	-	.09	.0045	.0001	-	-
-	1889*	-	-	.05	1.95	0.85	.0000	.0196	.0134	.0062	.08	.0020	.0000	-	-
-	1890†	-	-	.03	2.43	1.50	.0003	.0151	.0115	.0036	.08	.0050	.0000	-	0.3
-	1891‡	-	-	.00	1.90	0.85	.0000	.0122	.0122	.0000	.09	.0030	.0000	-	0.0
-	1892	-	-	.05	2.00	0.75	.0000	.0106	.0084	.0022	.11	.0050	.0000	-	0.3
-	1893	-	-	.08	1.67	0.75	.0010	.0094	.0077	.0017	.12	.0010	.0000	.1433	0.2
-	1894§	-	-	.10	1.70	0.70	.0002	.0097	.0080	.0017	.13	.0065	.0001	.2630	0.1
-	1895	-	-	.08	1.72	0.84	.0011	.0111	.0097	.0014	.13	.0035	.0000	.2199	0.3

* April. † August. ‡ September. § April and August.

NOTE to analyses of 1895: Odor, none; a faintly vegetable odor was developed in the first sample when heated, and a decidedly grassy odor in the last sample.——The first two and last samples were collected from the pond, about 5 feet beneath the surface. The third sample was collected from a pump drawing water from the pond.

ASHBURNHAM.

Microscopical Examination of Water from Upper Naukeag Pond, Ashburnham.

[Number of organisms per cubic centimeter.]

	1895.			
	Feb.	April.	July.	Aug.
Day of examination,	15	10	24	13
Number of sample,	13813	14122	14681	14801
PLANTS.				
Diatomaceæ,	0	4	13	62
Asterionella,	0	3	7	0
Cyclotella,	0	1	2	6
Synedra,	0	pr.	3	2
Tabellaria,	0	0	1	54
Cyanophyceæ,	0	0	50	40
Merismopedia,	0	0	48	12
Microcystis,	0	0	2	28
Algæ,	0	0	44	282
Protococcus,	0	0	40	276
Raphidium,	0	0	4	4
Staurastrum,	0	0	0	2
ANIMALS.				
Infusoria,	0	5	86	3
Dinobryon,	0	0	86	0
Dinobryon cases,	0	4	0	3
Peridinium,	0	1	0	0
Crustacea, Cyclops,	.01	0	.02	0
TOTAL,	0	9	193	387

ATHOL.

WATER SUPPLY OF ATHOL. — ATHOL WATER COMPANY.

Chemical Examination of Water from the Large Reservoir in Phillipston.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Suspended.		Nitrates.	Nitrites.		
	1895.														
13625	Jan. 8	Distinct.	Slight.	0.90	4.70	2.10	.0034	.0228	.0208	.0020	.17	.0070	.0000	.8580	1.4
13803	Feb. 12	Slight.	Slight.	1.10	4.85	2.10	.0002	.0234	.0190	.0044	.17	.0070	.0000	.9280	1.3
13954	Mar. 11	Distinct.	Slight.	0.58	3.50	1.40	.0006	.0276	.0162	.0114	.15	.0100	.0000	.6329	0.6
14265	May 8	Slight.	Cons.	0.63	2.90	1.60	.0006	.0150	.0114	.0036	.11	.0000	.0000	.6044	0.8
14639	July 15	Decided.	Cons.	0.30	3.00	1.00	.0014	.0298	.0124	.0174	.13	.0130	.0000	.3432	1.2
15213	Sept. 18	Decided, green.	Slight, green.	0.63	4.25	1.65	.0006	.1138	.0284	.0854	.16	.0070	.0000	.4797	0.6
15587	Nov. 20	Distinct.	Slight.	0.33	4.80	1.60	.0042	.0222	.0136	.0086	.22	.0330	.0000	.4524	1.4
Av.	....	....	....	0.64	4.00	1.64	.0016	.0364	.0174	.0190	.16	.0110	.0000	.6141	1.0

Averages by Years.

-	1887*	-	-	1.25	4.23	1.89	.0027	.0360	-	-	.16	.0075	-	-	-
-	1888†	-	-	0.80	3.22	1.17	.0010	.0157	-	-	.11	.0127	.0000	-	-
-	1894	-	-	0.45	3.75	1.39	.0019	.0179	.0112	.0067	.11	.0048	.0000	.4750	0.9
-	1895	-	-	0.64	4.00	1.64	.0016	.0364	.0174	.0190	.16	.0110	.0000	.6141	1.0

* June and December. † January to March.

NOTE to analyses of 1895: Odor, generally faintly vegetable; grassy in September. —— The samples were collected from the reservoir.

Microscopical Examination of Water from the Large Reservoir in Phillipston.

[Number of organisms per cubic centimeter.]

	1895.						
	Jan.	Feb.	Mar.	May.	July.	Sept.	Nov.
Day of examination,	9	14	13	9	18	19	22
Number of sample,	13625	13803	13954	14265	14639	15213	15587
PLANTS.							
Diatomaceæ,	**4**	**0**	**0**	**19**	**0**	**800**	**552**
Asterionella,	0	0	0	0	0	0	28
Melosira,	0	0	0	14	0	800	488
Synedra,	4	0	0	5	0	0	36
Cyanophyceæ,	**5**	**0**	**0**	**0**	**1,760**	**32,000**	**700**
Anabæna,	0	0	0	0	1,760	32,000	700
Aphanocapsa,	5	0	0	0	0	0	0

ATHOL.

Microscopical Examination of Water from the Large Reservoir in Phillipston — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Mar.	May.	July	Sept.	Nov.
PLANTS — Con.							
Algæ,	**0**	**0**	**4**	**0**	**0**	**50**	**7**
Pediastrum,	0	0	0	0	0	50	3
Raphidium,	0	0	0	0	0	0	4
Zoöspores,	0	0	4	0	0	0	0
Fungi, Crenothrix,	**0**	**0**	**0**	**1**	**31**	**0**	**3**
ANIMALS.							
Infusoria,	**194**	**342**	**2,027**	**0**	**2**	**100**	**20**
Dinobryon,	144	5	0	0	0	0	0
Dinobryon cases,	34	64	1,600	0	0	0	0
Euglena,	9	156	84	0	0	0	0
Mallomonas,	0	4	3	0	0	0	0
Monas,	0	0	0	0	0	50	0
Paramæcium,	0	0	0	0	0	50	0
Peridinium,	6	112	340	0	0	0	19
Trachelomonas,	1	1	0	0	2	0	1
Vermes,	**1**	**3**	**1**	**0**	**0**	**0**	**1**
Anurea,	0	1	0	0	0	0	1
Asplanchna,	0	1	0	0	0	0	0
Polyarthra,	0	0	1	0	0	0	0
Rotatorian ova,	0	1	0	0	0	0	0
Rotifer,	1	0	0	0	0	0	0
Miscellaneous,	**0**	**0**	**0**	**20**	**0**	**0**	**.04**
Acarina,	0	0	0	0	0	0	.04
Zoöglœa,	0	0	0	20	0	0	0
TOTAL,	204	345	2,032	40	1,793	32,950	1,283

Chemical Examination of Water from Newton Reservoir, Athol.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
14640	1895. July 15	V. slight.	Slight.	.30	2.95	1.10	.0000	.0108	.0086	.0022	.13	.0070	.0001	.3588	0.9

Odor, very faintly vegetable, disappearing on heating. —— The sample was collected from the reservoir.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 8; *Melosira*, 3; *Synedra*, 2. Algæ, *Glœocapsa*, 3; *Protococcus*, 14; *Raphidium*, 1. Fungi, *Crenothrix*, 1. Infusoria, *Dinobryon*, 125; *Dinobryon cases*, 14; *Peridinium*, 68. Crustacea, *Daphnia*, .04. Total, 239.

ATTLEBOROUGH.

WATER SUPPLY OF ATTLEBOROUGH.

Chemical Examination of Water from the Well of the Attleborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13641	Jan. 11	None.	None.	.03	4.40	.0000	.0024	.40	.0150	.0000	.0273	2.1	.0000
13812	Feb. 12	None.	None.	.03	3.70	.0002	.0040	.37	.0180	.0000	.0240	1.6	.0000
13981	Mar. 14	None.	None.	.02	3.00	.0000	.0032	.37	.0180	.0000	.0384	1.8	.0000
14308	May 14	None.	None.	.03	3.30	.0002	.0026	.34	.0120	.0000	.0355	1.6	.0020
14467	June 11	V.slight,†	None.	.05	4.20	.0000	.0034	.32	.0070	.0000	0546	1.6	.0030
14643	July 17	None.	None.	.03	3.90	.0000	.0026	.35	.0180	.0000	.0825	2.0	.0000
14877	Aug. 19	V. slight.	None.	.02	5.10	.0012	.0050	.38	.0080	.0000	.0858	1.9	.0030
14968	Sept. 4	None.	None.	.02	4.10	.0000	.0016	.37	.0120	.0000	.0370	1.8	.0100
15279	Sept. 30	None.	None.	.02	4.10	.0000	.0008	.35	.0100	.0000	.0156	1.8	.0030
15345	Oct. 9	None.	V. slight.	.02	4.30	.0000	.0012	.37	.0070	.0000	.0140	1.9	.0010
15506	Nov. 11	None.	None.	.04	4.50	.0000	.0020	.39	.0200	.0001	.0312	1.8	.0000
15720	Dec. 10	None.	None.	.02	3.70	.0000	.0018	.34	.0080	.0000	.0429	2.1	.0050
Av.*	....	....	....	.03	4.02	.0001	.0027	.36	.0129	.0000	.0420	1.8	.0019

Averages by Years.

-	1893	-	-	.02	4.43	.0000	.0008	.36	.0210	.0000	.0312	2.0	.0068
-	1894	-	-	.02	3.98	.0002	.0014	.37	.0193	.0000	.0353	1.8	.0043
-	1895	-	-	.03	4.02	.0001	.0027	.36	.0129	.0000	.0420	1.8	.0019

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average. † Milky.

NOTE to analyses of 1895: Odor, until August, none; the samples collected from August to December inclusive had generally a peculiar vinous odor which disappeared on heating.——The samples were collected from a faucet in the pumping station while pumping.

Microscopical Examination.

No. 14308. Miscellaneous, *Zoöglœa*, 12.
No. 14877. Miscellaneous, *Zoöglœa*, 1.
No organisms were found in the remaining samples.

The analyses of samples collected from faucets or hydrants at dead ends in various parts of the town have been found to contain large amounts of iron, though the results of analyses of samples collected at the pumping station indicate that the water as drawn from the well is practically free from iron. The cause of the presence of so large an amount of iron in the samples from dead ends has not yet been fully determined. In the following table are given the results of analyses of samples from several dead ends.

ATTLEBOROUGH.

Chemical Examination of Water from Faucets in Attleborough supplied from the Attleborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14787	Aug. 7	Distinct.	Cons., rusty.	.00	4.20	.0000	.0018	.38	.0150	.0000	.0468	2.6	.3000
14788	Aug. 7	Decided, rusty	Heavy, rusty.	.08	6.30	.0000	.0020	.33	.0080	.0001	.0390	2.3	.6000
14969	Sept. 4	Slight, milky.	Slight, rusty.	.10	3.60	0000	.0026	.37	.0010	.0003	.0693	1.7	.0550
14970	Sept. 4	Decided, yellow.	Cons., rusty.	.02	5.00	.0000	.0036	.39	.0050	.0003	.0755	2.5	.2900

Odor of the first sample, very faintly earthy, becoming stronger on heating; of the second, decidedly tarry; of the third, distinct, fragrant, disappearing on heating; of the last, none, becoming distinctly vegetable and unpleasant on heating. —— The samples were collected from hydrants on dead ends, the first and last on Forest street; the second 400 feet off force main from the pumping station to the standpipe; the third, on Robert Street. The hydrant on Robert Street was flushed the day before the sample was collected.

Microscopical Examination.

No. 14787, Fungi, *Crenothrix*, 6,000.
No. 14788, Fungi, *Crenothrix*, 3,960.
No. 14969, Fungi, *Crenothrix*, 162.
No. 14970, Fungi, *Crenothrix*, 4,200.

Chemical Examination of Water from Orr's Pond, Attleborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13982	Mar. 14	Distinct.	Slight.	.50	3.15	1.50	.0008	.0270	.0254	.0016	.30	.0050	.0000	.6064	0.6
15047	Sept. 7	Slight.	Slight.	.70	5.60	2.00	.0016	.0350	.0332	.0018	.38	.0000	.0002	.8112	1.9
15278	Sept. 30	Distinct, green.	Slight, green	.60	3.85	1.95	.0006	.0370	.0350	.0020	.36	.0030	.0000	.6474	1.1
15344	Oct. 9	V slight.	Slight.	.40	3.75	2.00	.0014	.0354	.0334	.0020	.36	.0000	.0000	.6146	1.4
Av.	....	....	....	.55	4.09	1.86	.0011	.0336	.0318	.0018	.35	.0020	.0001	.6699	1.3

Odor of the second sample, none; of the other samples, distinctly vegetable, mouldy or grassy. ——Orr's Pond is located just below the well of the Attleborough Water Works, at the confluence of Seven Mile River and Four Mile Brook.

Microscopical Examination.

The number of organisms per cubic centimeter found in each of these samples was as follows: No. 13982, 8; No. 15047, 33; No. 15278, 257; No. 15344, 234.

AVON.

Water Supply of Avon.

Chemical Examination of Water from the Well of the Avon Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
15125	Sept. 9	None.	None.	.00	4.00	.0002	.0002	.48	.0350	.0000	.0390	0.8	.0020

Odor, none. —— The sample was collected from a faucet at the pumping station while pumping.

Microscopical Examination.

No organisms.

Water Supply of Ayer.

Chemical Examination of Water from the Well of the Ayer Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid		Nitrates.	Nitrites.			
	1895.												
14546	June 26	None.	None.	.00	6.60	.0000	.0012	.40	.0450	.0000	.0231	2.7	.0000
14932	Aug. 28	None.	None.	.00	6.00	.0000	.0004	.60	.0750	.0000	.0000	2.3	.0030
15433	Oct. 28	None.	Slight.	.02	6.30	.0026	.0018	.50	.0800	.0000	.0218	2.7	.0010
Av.	....	....	....	.01	6.30	.0009	.0011	.50	.0667	.0000	.0150	2.6	.0013

Odor, none —— The first and second samples were collected from a faucet at the pumping station; the last, from the well.

Microscopical Examination.

An insignificant number of organisms was found in these samples.

Water Supply of Barre.

Population in 1895, 2,278. The works are owned by the Barre Water Company and were completed in October, 1895. The source of supply is a small storage reservoir in the northerly part of the town in which the water from several springs in the vicinity is collected. Water from springs in another watershed is also diverted into this reservoir by means of 700 feet of open trench and about 2,100 feet of earthern pipe.

The combined watersheds tributary to the storage reservoir contain about 275 acres of hilly country, half of which is wooded, the remainder being largely pasture land. There are a few houses on the watersheds.

The storage reservoir was made by excavating in a depression and building a dyke around the edges, material for the dyke being taken from the excavation. The bottom of the reservoir is of hard pan. Its area when full is 4.25 acres, its depth 10 feet, and its capacity 10,000,000 gallons.

Water is distributed by gravity. Distributing mains are of cast iron and service pipes of wrought iron lined with cement.

The advice of the State Board of Health to the Barre Water Company relative to taking water from this source as a public water supply may be found on pages 8 and 9 of the annual report for 1894, and analyses of samples of water collected during the investigation with reference to a water supply may be found on page 83 of the same volume.

Water Supply of Belmont.

(See *Watertown*.)

Water Supply of Beverly.

(See *Salem*.)

Billerica.

The advice of the State Board of Health to J. Nelson Parker and others of the town of Billerica, with reference to the use of Nutting's Pond in that town as a source of public water supply, may be found on pages 14 and 15 of this volume. Analyses of samples of water collected at different parts of the pond are given on the following page.

BILLERICA.

Chemical Examination of Water from Nutting's Pond, Billerica.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14052	Mar. 28	Distinct.	Slight, green.	0.70	4.05	1.55	.0030	.0290	.0184	.0106	.32	.0070	.0001	.7238	1.6
14723	July 27	Slight.	Slight.	0.85	4.15	1.90	.0026	.0260	.0246	.0014	.47	.0070	.0000	.4158	1.7
15225	Sept. 20	Slight.	Slight.	0.67	4.45	2.05	.0000	.0232	.0222	.0010	.46	.0050	.0000	.6396	0.9
15226	Sept. 20	Distinct.	Slight.	0.63	4.30	1.85	.0006	.0236	.0230	.0006	.44	.0060	.0000	.6162	0.9
15227	Sept. 20	Slight.	Slight.	1.10	5.35	2.40	.0002	.0296	.0284	.0012	.48	.0070	.0000	.9477	1.6

Odor, vegetable, becoming stronger on heating.—— The samples were collected from the pond at different points, as follows: No. 14052 at the causeway where the pond is crossed by the Middlesex turnpike; No. 14723 from the west side near the road; No. 15225 from west end of west half of pond; No. 15226 from east end of west half of pond. No. 15227 from middle of east half of pond.

Microscopical Examination of Water from Nutting's Pond, Billerica.

[Number of organisms per cubic centimeter.]

	1895. March.	1895. July.	1895. Sept.	1895. Sept.	1895. Sept.
Day of examination,	30	31	21	21	21
Number of sample,	14052	14723	15225	15226	15227
PLANTS.					
Diatomaceæ,	**0**	**2**	**1**	**5**	**32**
Melosira,	0	0	0	5	32
Synedra,	0	2	1	0	0
Cyanophyceæ,	**0**	**17**	**79**	**7**	**7**
Merismopedia,	0	6	49	0	0
Microcystis,	0	11	30	7	7
Algæ, Protococcus,	**320**	**0**	**35**	**0**	**0**
ANIMALS.					
Infusoria,	**312**	**3**	**2**	**0**	**0**
Codonella,	0	0	1	0	0
Cryptomonas,	200	0	0	0	0
Dinobryon,	4	0	0	0	0
Dinobryon cases,	8	0	0	0	0
Mallomonas,	0	1	0	0	0
Synura,	100	0	0	0	0
Tintinnidium,	0	2	1	0	0

BILLERICA.

Microscopical Examination of Water from Nutting's Pond, Billerica — Concluded.

[Number of organisms per cubic centimeter.]

	1895.				
	March.	July.	Sept.	Sept.	Sept.
ANIMALS — Con.					
Vermes,	0	0	0	1	1
Anurea,	0	0	0	0	1
Rotatorian ova,	0	0	0	1	0
Crustacea, Cyclops,	0	.04	0	0	0
Miscellaneous, Acarina,	0	0	0	0	.10
TOTAL,	632	22	117	13	40

WATER SUPPLY OF BOSTON.

The results of analyses of water from reservoir No. 6 given on pages 98–101 indicate that the quality has remained about the same as last year, that there has been no large growth of organisms and that during the period of summer stagnation there has been only a comparatively small accumulation of the products of decomposition at the bottom of the reservoir.

The color of the water supplied to the city from the Cochituate Works in 1895, as indicated by the averages of analyses given on page 115, again shows a slight increase over the previous year. The higher color of recent years is due, as noted in previous reports, to the increasing proportion of Sudbury River water supplied to the city.

As stated in the annual report for 1894, the odor of the water of Mystic Lake became extremely offensive in the latter part of 1894 and early in 1895, so that many of the water consumers found it necessary to obtain well or spring water for drinking. This condition continued through the winter for a period of several weeks, but the quality of the water improved with the breaking up of the ice upon the lake.

The water of Stony Brook above Reservoir No. 3, and of the reservoir itself, has been unfavorably affected, during this year as last, by work incidental to the construction of Dam No. 5 and the stripping of the basin to be formed by this dam. In consequence of this work the use of water from reservoir No. 3 has been avoided, as far as possible.

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Indian Brook at Head of Reservoir No. 6, Hopkinton.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13562	Jan. 1	V.slight.	V slight.	1.80	6.75	3.60	.0010	.0300	.0282	.0018	1.02	.0000	.0000	1.8865	1.9
13740	Feb. 4	V.slight.	V slight.	1.80	6.45	3.45	.0000	.0276	.0258	.0018	.51	.0070	.0000	2.3305	1.7
13906	Mar. 4	V.slight.	V.slight.	1.30	5.50	2.30	.0016	.0276	.0250	.0026	.57	.0070	.0000	1.2998	1.7
14059	Apr. 1	V.slight	V.slight.	1.30	3.65	2.30	.0006	.0250	.0206	.0044	.31	.0030	.0001	0.9586	0.8
14229	May 1	V.slight.	Slight.	1.80	4.90	2.75	.0012	.0312	.0274	.0038	.47	.0020	.0001	1.8711	1.3
14399	June 3	Slight.	Slight.	3.00	7.20	4.00	.0018	.0478	.0454	.0024	.35	.0020	.0000	2.5460	1.9
14565	July 1	V.slight.	Slight.	1.80	6.35	3.20	.0012	.0428	.0392	.0036	.43	.0000	.0001	1.6353	1.6
14742	Aug. 1	Slight.	Slight.	1.90	8.30	5.15	.0008	.0620	.0580	.0040	.55	.0000	.0000	2.7720	2.3
14942	Sept. 2	V.slight.	V slight.	1.60	7.15	3.50	.0010	.0408	.0386	.0022	.77	.0020	.0000	1.9404	1.6
15281	Oct. 1	Slight.	Slight.	1.10	7.25	2.80	.0000	.0390	.0326	.0064	.83	.0030	.0000	1.2129	1.9
15462	Nov. 4	None.	V.slight	1.80	6.05	3.70	.0002	.0338	.0318	.0020	.52	.0070	.0001	2.2776	1.3
15646	Dec. 2	None.	V.slight.	1.50	4.50	2.55	.0004	.0214	.0194	.0020	.36	.0020	.0000	1.3416	0.8
Av.	1895	....	....	1.72	6.17	3.28	.0008	.0358	.0327	.0031	.56	.0029	.0000	1.8394	1.6
Av.	1894	....	....	2.16	6.58	3.38	.0014	.0323	.0300	.0024	.54	.0018	.0000	1.7839	1.6

NOTE to analyses of 1895: Odor, generally vegetable and frequently also mouldy.——The samples were collected from the brook, at its entrance into Reservoir No. 6.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 75.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 6, Ashland, collected near the Surface.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13564	Jan. 1	V.slight.	V.slight.	0.75	4.40	2.05	.0034	.0234	.0224	.0010	.43	.0020	.0000	.6930	1.4
14060	Apr. 1	Distinct.	Slight.	0.75	4.15	1.95	.0038	.0214	.0204	.0010	.41	.0100	.0001	.7584	1.1
14230	May 1	V.slight.	Slight.	0.90	4.20	2.00	.0030	.0176	.0166	.0010	.38	.0100	.0001	.7492	1.4
14401	June 3	Distinct, green.	Slight.	0.73	4.05	1.50	.0010	.0272	.0212	.0060	.39	.0050	.0001	.7410	1.3
14566	July 1	Slight	Cons.	0.68	4.30	1.95	.0002	.0246	.0222	.0024	.38	.0030	.0000	.7244	1.1
14743	Aug. 1	Distinct, green.	Cons., green.	0.53	4.20	1.30	.0000	.0244	.0208	.0036	.37	.0000	.0000	.7007	2.1
14943	Sept. 2	Distinct.	Slight.	0.45	3.95	1.60	.0000	.0222	.0182	.0040	.40	.0030	.0000	.6252	1.1
15282	Oct. 1	Distinct.	Slight.	0.40	3.80	1.55	.0000	.0226	.0190	.0036	.39	.0030	.0000	.5538	1.3
15461	Nov. 4	Distinct.	Slight.	1.00	4.25	2.45	.0018	.0260	.0232	.0028	.46	.0070	.0001	1.0374	1.1
15647	Dec. 2	Distinct.	Slight.	1.10	4.25	2.30	.0034	.0294	.0262	.0032	.35	.0050	.0000	1.0335	0.9
Av.	1895	....	....	0.73	4.15	1.86	.0017	.0239	.0210	.0029	.40	.0048	.0000	.7617	1.3
Av.	1894	....	....	0.79	3.93	1.59	.0013	.0191	.0166	.0025	.40	.0040	.0001	.7466	1.2

NOTE to analyses of 1895: Odor, vegetable, frequently also unpleasant or disagreeable The iron was determined in five samples, the average amount in parts per 100,000 being .0139.——The samples were collected from the reservoir near the dam. For monthly record of height of water in this reservoir see table at end of Boston analyses.

BOSTON.

SUDBURY RIVER SUPPLY. — *Microscopical Examination of Water from Reservoir No. 6, Ashland, collected near the Surface.*

[Number of organisms per cubic centimeter.]

	1895.									
	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	2	4	2	2	4	2	5	3
Number of sample,	13564	14060	14230	14401	14566	14743	14943	15282	15461	15647
PLANTS.										
Diatomaceæ,	3	0	4	1,133	722	1,689	29	143	41	17
Cyclotella,	0	0	0	21	680	1,680	15	136	40	11
Diatoma,	0	0	0	0	0	0	6	1	0	4
Melosira,	0	0	0	30	0	0	0	0	0	0
Navicula,	0	0	0	6	0	0	1	0	0	0
Synedra,	3	0	4	1,072	32	0	0	2	1	2
Tabellaria,	0	0	0	4	10	9	7	4	0	0
Cyanophyceæ, Anabæna,	0	0	0	0	0	52	0	0	0	0
Algæ,	14	0	1	28	4	4	321	455	21	31
Arthrodesmus,	0	0	0	4	4	0	0	3	1	1
Chlorococcus,	14	0	0	0	0	0	7	5	0	0
Glœocapsa,	0	0	0	0	0	2	4	0	0	0
Protococcus,	0	0	1	24	0	0	204	432	12	13
Raphidium,	0	0	0	0	0	0	96	14	8	17
Staurastrum,	0	0	0	0	0	2	5	0	0	0
Staurogenia,	0	0	0	0	0	0	5	1	0	0
ANIMALS.										
Infusoria,	10	43	7	76	9	0	3	18	0	3
Cryptomonas,	2	0	0	0	0	0	0	0	0	0
Dinobryon,	0	32	2	54	0	0	0	15	0	0
Dinobryon cases,	0	10	4	22	0	0	0	0	0	0
Peridinium,	7	1	1	0	3	0	1	0	0	3
Synura,	1	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	1	2	0	0
Vorticella,	0	0	0	0	6	0	1	1	0	0
Vermes, Rotifer,	0		0	0	0	0	0	0	5	0
Miscellaneous, Zoöglœa,	0	1	0	0	0	0	3	100	19	5
TOTAL,	27	46	12	1,237	735	1,745	356	716	86	56

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 6, Ashland, collected near the Bottom.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13563	Jan. 1	V.slight.	Slight.	0.60	3.95	1.80	.0022	.0212	.0186	.0026	.41	.0030	.0000	.6506	1.4
13742	Feb. 4	V.slight.	V.slight.	0.65	4.35	1.90	.0030	.0194	.0178	.0016	.48	.0070	.0000	.9085	1.4
13908	Mar. 4	V slight.	V.slight.	0.80	5.10	1.90	.0050	.0232	.0218	.0014	.47	.0100	.0000	.7407	1.7
14061	Apr. 1	Distinct.	Slight.	0.80	4.20	1.70	.0042	.0202	.0192	.0010	.43	.0050	.0001	.8378	1.1
14231	May 1	V.slight.	Slight.	0.90	4.15	1.90	.0036	.0180	.0166	.0014	.35	.0120	.0001	.7392	1.4
14400	June 3	Slight.	Slight.	0.70	4.05	1.75	.0016	.0182	.0170	.0012	.39	.0110	.0000	.6688	1.7
14567	July 1	Slight.	Slight.	0.65	4.00	1.80	.0036	.0178	.0160	.0018	.38	.0100	.0000	.6731	1.1
14744	Aug. 1	Slight.	Slight.	0.65	4.65	1.95	.0014	.0160	.0142	.0018	.38	.0070	.0001	.6699	1.4
14944	Sept. 2	Decided.	Cons.	0.75	4.55	2.00	.0130	.0218	.0142	.0076	.43	.0000	.0003	.6275	1.1
15283	Oct. 1	Distinct, clayey.	Cons., earthy.	0.40	4.20	1.80	.0000	.0218	.0180	.0038	.40	.0030	.0000	.5655	1.3
15463	Nov. 4	Distinct.	Slight.	1.00	4.60	2.55	.0022	.0250	.0232	.0018	.44	.0060	.0002	1.0686	1.3
15648	Dec. 2	Distinct.	Slight.	1.15	4.20	2.20	.0038	.0224	.0212	.0012	.36	.0030	.0000	1.0374	0.9
Av.	1895	....	....	0.75	4.33	1.94	.0036	.0204	.0181	.0023	.41	.0064	.0001	.7656	1.3
Av.	1894*	....	....	1.01	4.08	1.73	.0082	.0175	.0149	.0026	.38	.0026	.0004	.6724	1.2

* April to December.

NOTE to analyses of 1895: Odor, generally distinctly vegetable and occasionally unpleasant. The iron was determined in seven samples, the average amount in parts per 100,000 being .0216. —— The samples were collected from the reservoir near the dam.

BOSTON.

SUDBURY RIVER SUPPLY. — *Microscopical Examination of Water from Reservoir No. 6, Ashland, collected near the Bottom.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	5	2	2	4	2	2	4	2	5	3
Number of sample,	13563	13742	13908	14061	14231	14400	14567	14744	14944	15283	15463	15648
PLANTS.												
Diatomaceæ,	**30**	**0**	**4**	**1**	**6**	**49**	**35**	**1,084**	**100**	**211**	**36**	**4**
Cyclotella,	0	0	0	0	0	2	0	1,080	96	208	28	2
Diatoma,	0	0	0	0	0	0	0	0	4	2	0	2
Melosira,	0	0	0	1	0	2	4	0	0	0	0	0
Synedra,	26	0	4	0	6	42	28	2	0	0	0	0
Tabellaria,	4	0	0	0	0	3	3	2	0	1	8	0
Algæ,	**0**	**0**	**0**	**0**	**6**	**14**	**0**	**0**	**0**	**264**	**28**	**52**
Protococcus,	0	0	0	0	6	14	0	0	0	260	16	0
Raphidium,	0	0	0	0	0	0	0	0	0	4	12	52
Fungi, Crenothrix,	**0**	**0**	**4**	**0**	**0**	**18**	**9**	**0**	**10**	**1**	**0**	**0**
ANIMALS.												
Infusoria,	**1**	**3**	**pr.**	**102**	**3**	**0**	**2**	**24**	**0**	**10**	**1**	**0**
Conochilus,	0	0	0	0	0	0	0	0	0	2	0	0
Dinobryon,	0	0	0	58	0	0	0	0	0	0	0	0
Dinobryon cases,	0	0	0	44	2	0	0	0	0	0	0	0
Peridinium,	1	1	pr.	0	1	0	0	24	0	0	0	0
Synura,	0	1	0	pr.	0	0	0	0	0	0	0	0
Tintinnidium,	0	0	0	0	0	0	0	0	0	2	0	0
Trachelomonas,	0	1	pr.	0	0	0	1	0	0	5	1	0
Vorticella,	0	0	0	0	0	0	1	0	0	1	0	0
Vermes, Rotifer,	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Miscellaneous, Zoöglœa,	**0**	**0**	**74**	**0**	**0**	**0**	**0**	**0**	**1,680**	**200**	**20**	**0**
TOTAL,	31	3	82	103	16	81	46	1,108	1,790	686	86	56

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Cold Spring Brook, at Head of Reservoir No. 4, Ashland.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13565	Jan. 1	V. slight.	V. slight.	1.50	5.35	2.45	.0008	.0260	.0240	.0020	.34	.0030	.0000	1.3860	1.7
13748	Feb. 4	V. slight.	Slight.	1.30	5.10	2.25	.0028	.0260	.0228	.0032	.35	.0070	.0000	1.3825	1.1
13909	Mar. 4	V. slight.	Slight.	1.05	4.55	1.80	.0002	.0232	.0220	.0012	.33	.0070	.0000	.9610	1.1
14062	Apr. 1	Slight.	V. slight.	1.10	3.70	2.25	.0002	.0258	.0230	.0028	.36	.0030	.0000	.9086	0.8
14220	May 1	V. slight.	V. slight.	1.50	4.60	2.75	.0000	.0340	.0294	.0046	.36	.0020	.0001	1.2320	1.3
14402	June 3	Distinct.	Slight.	1.30	4.20	2.30	.0012	.0300	.0282	.0018	.27	.0030	.0001	1.0830	0.9
14568	July 1	Slight.	Slight.	0.90	3.85	1.95	.0004	.0276	.0252	.0024	.31	.0000	.0000	.8469	1.1
14745	Aug. 1	Slight.	Slight.	0.90	5.45	2.65	.0000	.0292	.0284	.0008	.32	.0070	.0000	1.0703	1.6
14949	Sept. 3	V. slight.	Slight.	0.70	4.35	2.15	.0004	.0214	.0198	.0016	.34	.0030	.0000	.6006	1.2
15284	Oct. 1	Distinct, clayey.	Slight, earthy.	0.50	3.55	1.45	.0012	.0250	.0202	.0048	.31	.0030	.0000	.5616	1.1
15464	Nov. 4	V. slight.	V. slight.	1.85	6.90	4.40	.0000	.0446	.0426	.0020	.32	.0030	.0001	2.3244	1.6
15649	Dec. 2	V. slight.	V. slight.	1.70	4.80	2.95	.0006	.0292	.0274	.0018	.21	.0000	.0000	1.5444	0.9
Av.	....	....	....	1.19	4.70	2.45	.0006	.0285	.0261	.0024	.32	.0034	.0000	1.1584	1.2

Averages by Years.

-	1889*	-	-	2.24	-	-	.0025	.0410	.0385	.0025	.28	.0056	.0001	-	-
-	1890	-	-	0.91	4.49	2.01	.0011	.0243	.0210	.0033	.24	.0090	.0001	-	1.5
-	1891	-	-	1.30	4.87	2.30	.0009	.0297	.0262	.0035	.23	.0087	.0001	-	1.3
-	1892	-	-	1.44	5.15	2.57	.0003	.0308	.0266	.0042	.25	.0068	.0001	-	1.2
-	1893	-	-	1.23	4.52	2.16	.0013	.0248	.0212	.0036	.26	.0031	.0001	.9765	1.3
-	1894	-	-	1.44	4.94	2.42	.0007	.0237	.0214	.0023	.31	.0043	.0000	1.1952	1.2
-	1895	-	-	1.19	4.70	2.45	.0006	.0285	.0261	.0024	.32	.0034	.0000	1.1584	1.2

* June to December.

NOTE to analyses of 1895: Odor, vegetable. —— The samples were collected from the brook at its entrance into Reservoir No. 4.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 68.

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, Ashland.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13566	Jan. 1	Slight.	Slight.	1.00	4.75	1.90	.0036	.0298	.0262	.0036	.37	.0020	.0000	.9432	1.7
13749	Feb. 4	V. slight.	V slight.	1.30	5.70	2.55	.0032	.0270	.0252	.0018	.43	.0180	.0000	1.3983	1.3
13910	Mar. 4	V. slight.	V. slight.	0.85	4.25	1.70	.0072	.0210	.0204	.0006	.32	.0100	.0000	.8455	1.4
14063	Apr. 1	V. slight.	V. slight.	0.90	4.15	2.20	.0018	.0264	.0240	.0024	.34	.0090	.0001	.9355	1.3
14221	May 1	V. slight.	V. slight.	0.90	4.15	2.25	.0008	.0208	.0192	.0016	.31	.0080	.0000	.8470	1.1
14403	June 3	Distinct.	Slight.	0.95	3.90	2.05	.0006	.0266	.0244	.0022	.29	.0020	.0000	.9424	1.1
14569	July 1	Slight.	Slight.	0.90	4.20	2.10	.0006	.0236	.0202	.0034	.28	.0000	.0000	.8113	0.9
14746	Aug. 1	Slight.	Slight.	0.68	4.10	1.75	.0002	.0258	.0240	.0018	.30	.0050	.0000	.8008	1.3
14950	Sept. 3	Slight.	Slight.	0.60	3.65	1.80	.0000	.0184	.0168	.0016	.33	.0000	.0000	.6684	0.6
15285	Oct. 1	Distinct, clayey.	Slight, earthy.	0.60	3.50	1.70	.0000	.0230	.0180	.0050	.30	.0030	.0000	.6006	0.9
15465	Nov. 4	Distinct.	Slight.	0.90	3.95	2.15	.0002	.0238	.0212	.0026	.35	.0050	.0002	.9087	1.1
15650	Dec. 2	Distinct.	Slight.	1.15	4.35	2.30	.0004	.0288	.0278	.0010	.21	.0000	.0000	1.1544	0.9
Av.	....	....	....	0.89	4.22	2.04	.0015	.0246	.0223	.0023	.32	.0052	.0000	.9047	1.1

Averages by Years.

-	1887*	-	-	0.74	3.71	1.51	.0005	.0246	-	-	.25	.0033	-	-	-
-	1888	-	-	0.72	3.83	1.70	.0007	.0277	-	-	.22	.0054	.0001	-	-
-	1889	-	-	0.85	3.48	1.98	.0016	.0251	.0218	.0033	.23	.0068	.0002	-	-
-	1890	-	-	0.61	3.67	1.40	.0008	.0222	.0191	.0031	.24	.0096	.0001	-	1.7
-	1891	-	-	0.53	3.24	1.55	.0006	.0187	.0156	.0031	.20	.0062	.0001	-	0.9
-	1892	-	-	0.64	3.60	1.52	.0002	.0200	.0168	.0032	.23	.0061	.0001	-	1.1
-	1893	-	-	0.77	3.54	1.63	.0024	.0206	.0173	.0033	.23	.0048	.0001	.6773	1.0
-	1894	-	-	0.83	4.00	1.73	.0027	.0202	.0180	.0022	.29	.0045	.0001	.7840	1.1
-	1895	-	-	0.89	4.22	2.04	.0015	.0246	.0223	.0023	.32	.0052	.0000	.9047	1.1

* June to December.

NOTE to analyses of 1895: Odor, vegetable, generally stronger on heating. The iron was determined in six samples, the average amount in parts per 100,000 being .0075. —— The samples were collected from the reservoir near the gate-house, 1 foot beneath the surface. For monthly record of height of water in this reservoir see table at end of Boston analyses.

BOSTON.

SUDBURY RIVER SUPPLY. — *Microscopical Examination of Water from Reservoir No. 4, Ashland.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
Day of examination,	2	5	6	3	1	4	3	2	4	2	5	3
Number of sample,	13566	13749	13910	14063	14221	14403	14569	14746	14950	15285	15465	15650
PLANTS.												
Diatomaceæ,	0	1	0	3	23	105	173	495	60	124	84	65
Cyclotella,	0	1	0	2	0	100	140	468	60	100	40	28
Diatoma,	0	0	0	0	0	0	0	20	0	0	0	0
Synedra,	0	0	0	1	14	4	32	2	0	24	44	37
Tabellaria,	0	0	0	pr.	9	1	1	5	0	0	0	0
Cyanophyceæ, Microcystis,	0	0	0	0	0	2	6	0	0	0	0	0
Algæ,	0	0	0	0	0	22	0	39	0	13	6	9
Glœocapsa,	0	0	0	0	0	0	0	17	0	0	0	0
Protococcus,	0	0	0	0	0	22	0	20	0	4	6	0
Raphidium,	0	0	0	0	0	0	0	2	0	9	0	9
Fungi, Crenothrix,	0	0	2	2	1	0	2	0	0	0	0	0
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	1	0	0	0	0	0	1	0
Infusoria,	0	0	pr.	9	5	0	0	0	0	1	0	1
Dinobryon cases,	0	0	0	9	1	0	0	0	0	0	0	0
Trachelomonas,	0	0	pr.	0	0	0	0	0	0	0	0	1
Vorticella,	0	0	0	0	1	0	0	0	0	1	0	0
Vorticella stems,	0	0	0	pr.	3	0	0	0	0	0	0	0
Vermes,	7	0	0	0	0	1	2	0	0	0	0	0
Anurea,	4	0	0	0	0	0	2	0	0	0	0	0
Rotatorian ova,	2	0	0	0	0	0	0	0	0	0	0	0
Rotifer,	1	0	0	0	0	1	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	0	0	0	5	0	4	0	8	60	20	7
TOTAL,	7	1	·2	14	35	130	187	534	68	198	111	82

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, Ashland, collected Twenty Feet beneath the Surface.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14570	July 1	V. slight.	Slight.	0.95	3.80	1.85	.0042	.0204	.0186	.0018	.30	.0070	.0000	.8800	0.9

Odor, distinctly vegetable and sweetish. Iron, .0070.

Microscopical Examination.

Diatomaceæ, *Cyclotella*, 136; *Synedra*, 10; *Tabellaria*, 1. Algæ, *Protococcus*, 18; *Raphidium*, 5. Infusoria, *Trachelomonas*, 1. Total, 171.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, Ashland, collected near the Bottom.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14571	July 1	V. slight.	V. slight.	0.90	3.75	1.70	.0030	.0192	.0176	.0016	.31	.0050	.0001	.7955	0.9
14747	Aug. 1	V. slight.	V. slight.	0.70	4.40	1.45	.0010	.0202	.0190	.0012	.30	.0070	.0000	.8393	1.3

Odor of the first sample, distinctly vegetable and sweetish; of the last, faintly vegetable. Iron in the first sample, .0150; in the last, not determined.

Microscopical Examination.

No. 14571. Diatomaceæ, *Cyclotella*, 48; *Synedra*, 1. Algæ, *Protococcus*, 1. Total, 50.
No. 14747. Diatomaceæ, *Cyclotella*, 36; *Diatoma*, 4; *Synedra*, 14; *Tabellaria*, 1. Total, 55.

BOSTON.

SUDBURY RIVER SUPPLY.— *Chemical Examination of Water from Sudbury River, at Head of Reservoir No. 2, Ashland.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13567	Jan. 1	Slight.	Slight.	1.30	5.25	1.95	.0016	.0304	.0252	.0052	.45	.0150	.0000	0.9894	1.7
13743	Feb. 4	V. slight.	Slight.	1.30	5.60	2.50	.0034	.0440	.0418	.0022	.47	.0170	.0000	1.1850	1.3
13911	Mar. 4	Slight.	Cons.	0.80	4.25	1.20	.0032	.0186	.0172	.0014	.33	.0150	.0000	0.7407	1.3
14064	Apr. 1	V. slight.	Slight.	0.73	3.65	1.95	.0002	.0276	.0260	.0016	.29	.0050	.0000	0.7199	0.8
14222	May 1	Slight.	Cons.	1.05	4.25	2.10	.0004	.0256	.0234	.0022	.36	.0100	.0001	0.9201	1.1
14404	June 3	Distinct.	Slight.	1.25	5.00	2.60	.0038	.0378	.0342	.0036	.36	.0070	.0001	1.1172	1.1
14559	July 1	Slight.	Slight, brown.	1.60	5.20	2.60	.0012	.0386	.0372	.0014	.28	.0030	.0001	1.3011	1.1
14748	Aug. 1	Slight, clayey.	Cons., brown.	0.87	4.95	1.85	.0004	.0332	.0318	.0014	.34	.0050	.0001	0.8624	1.1
14952	Sept. 3	Slight.	Slight.	0.85	4.80	2.40	.0016	.0284	.0236	.0048	.41	.0050	.0002	0.8031	0.9
15286	Oct. 1	Distinct, clayey	Slight.	0.68	3.95	1.85	.0000	.0278	.0260	.0018	.38	.0030	.0000	0.6903	0.9
15466	Nov. 4	None.	V. slight	1.35	5.45	3.20	.0000	.0298	.0272	.0026	.37	.0100	.0003	1.5990	0.9
15651	Dec. 2	Distinct.	Slight.	1.10	4.20	2.25	.0008	.0192	.0178	.0014	.25	.0080	.0000	0.9984	0.6
Av.	....	....	....	1.07	4.71	2.20	.0014	.0301	.0276	.0025	.36	.0086	.0001	0.9939	1.1

Averages by Years.

-	1887*	-	-	1.13	5.37	1.81	.0021	.0313	-	-	.39	.0170	-	-	-
-	1888	-	-	1.19	4.76	2.07	.0018	.0293	-	-	.29	.0108	.0002	-	-
-	1889	-	-	1.25	3.62	1.38	.0013	.0294	.0267	.0027	.30	.0080	.0002	-	-
-	1890	-	-	0.82	5.18	2.09	.0014	.0256	.0220	.0036	.30	.0135	.0001	-	1.7
-	1891	-	-	0.88	4.35	1.81	.0008	.0274	.0236	.0038	.26	.0112	.0001	-	1.1
-	1892	-	-	1.00	4.71	2.08	.0006	.0247	.0214	.0033	.28	.0099	.0001	-	1.3
-	1893	-	-	0.99	4.57	2.03	.0019	.0232	.0196	.0036	.34	.0068	.0001	0.8219	1.4
-	1894	-	-	1.31	4.68	2.17	.0007	.0231	.0211	.0020	.34	.0059	.0001	1.0566	1.2
-	1895	-	-	1.07	4.71	2.20	.0014	.0301	.0276	.0025	.36	.0086	.0001	0.9939	1.1

* June to December.

NOTE to analyses of 1895: Odor, vegetable, occasionally mouldy or unpleasant.—— The samples were collected from the river near the old dam at the upper end of Reservoir No. 2, at a depth of 1 foot beneath the surface.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 109.

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 2, Framingham.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
13568	Jan. 1	V. slight.	V. slight.	1.30	5.15	2.35	.0010	.0238	.0210	.0028	.38	.0070	.0000	1.2320	1.7
13744	Feb. 4	V. slight.	V. slight.	1.10	5.15	2.05	.0004	.0196	.0160	.0036	.38	.0150	.0000	1.0665	1.3
13912	Mar. 4	V. slight.	V slight.	0.90	5.10	1.85	.0028	.0184	.0146	.0038	.39	.0280	.0001	.8008	1.4
14065	Apr. 1	V. slight.	V. slight.	0.70	3.70	1.75	.0010	.0160	.0148	.0012	.28	.0100	.0001	.6352	0.9
14223	May 1	Slight.	Slight.	1.00	4.10	1.95	.0014	.0198	.0178	.0020	.32	.0100	.0001	.8123	1.1
14405	June 3	Decided.	Cons., brown.	1.05	4.10	1.75	.0004	.0262	.0242	.0020	.31	.0040	.0004	.9500	1.3
14560	July 1	Distinct.	Slight, yellow.	1.30	4.60	1.50	.0054	.0284	.0264	.0020	.30	.0030	.0001	1.0167	1.1
14749	Aug. 1	Distinct, clayey.	Slight.	0.70	4.55	1.90	.0010	.0246	.0210	.0036	.40	.0050	.0001	.7392	1.3
14953	Sept. 3	Slight.	Cons.	0.85	4.50	1.90	.0004	.0278	.0230	.0048	.40	.0050	.0002	.7777	1.1
15287	Oct. 1	Distinct, clayey.	Slight, earthy.	0.53	3.90	1.85	.0002	.0266	.0224	.0042	.36	.0030	.0000	.6240	1.3
15467	Nov. 4	V. slight.	V. slight.	1.70	6.45	3.35	.0036	.0368	.0286	.0082	.36	.0100	.0002	2.0670	1.3
15652	Dec. 2	Distinct.	Slight.	1.20	4.55	2.45	.0010	.0248	.0238	.0010	.24	.0080	.0000	1.0826	0.8
Av.	....	....	....	1.03	4.65	2.05	.0015	.0244	.0211	.0033	.34	.0090	.0001	.9837	1.2

Averages by Years.

-	1887*	-	-	1.09	4.94	1.87	.0015	.0335	-	-	.34	.0048	-	-	-
-	1888	-	-	1.08	4.63	2.01	.0005	.0300	-	-	.30	.0102	.0001	-	-
-	1889	-	-	1.04	3.42	1.26	.0015	.0296	.0252	.0044	.29	.0075	.0002	-	-
-	1890	-	-	0.77	4.58	1.83	.0010	.0235	.0191	.0044	.28	.0128	.0001	-	1.7
-	1891	-	-	0.72	4.02	1.68	.0004	.0230	.0194	.0036	.24	.0105	.0001	-	1.0
-	1892	-	-	0.89	4.35	1.92	.0004	.0231	.0192	.0039	.29	.0082	.0001	-	1.3
-	1893	-	-	0.98	4.28	1.86	.0010	.0219	.0190	.0029	.31	.0054	.0001	.8120	1.2
-	1894	-	-	1.12	4.36	2.05	.0008	.0216	.0193	.0023	.33	.0058	.0000	.9268	1.3
-	1895	-	-	1.03	4.65	2.05	.0015	.0244	.0211	.0033	.34	.0090	.0001	.9837	1.2

* June to December.

NOTE to analyses of 1895: Odor, vegetable.——The samples were collected from the reservoir, near the gate-house, at a depth of 8 feet beneath the surface. For monthly record of height of water in this reservoir, see table at end of Boston analyses.

BOSTON.

Sudbury River Supply. — *Microscopical Examination of Water from Reservoir No. 2, Framingham.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	6	3	1	4	2	2	4	2	6	3
Number of sample,	13568	13744	13912	14065	14223	14405	14560	14749	14953	15287	15467	15652
PLANTS.												
Diatomaceæ,	**16**	**5**	**3**	**11**	**60**	**156**	**469**	**374**	**535**	**236**	**6**	**18**
Cyclotella,	0	0	0	0	0	67	456	372	528	216	0	0
Melosira,	3	0	0	1	2	0	1	0	0	5	0	0
Navicula,	0	0	0	pr.	2	10	3	0	2	2	0	0
Pinnularia,	0	0	0	0	0	0	1	0	2	4	0	0
Synedra,	4	4	3	3	48	74	5	2	3	9	5	12
Tabellaria,	9	1	0	7	8	5	3	0	0	0	1	6
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**1**	**22**	**3**	**0**	**3**	**0**	**0**
Merismopedia,	0	0	0	0	0	0	22	0	0	0	0	0
Microcystis,	0	0	0	0	0	1	0	3	0	3	0	0
Algæ,	**0**	**0**	**1**	**0**	**4**	**47**	**148**	**88**	**88**	**114**	**0**	**0**
Glœocapsa,	0	0	0	0	0	0	84	2	0	0	0	0
Protococcus,	0	0	1	0	3	18	61	27	55	108	0	0
Raphidium,	0	0	0	0	0	10	0	20	28	6	0	0
Scenedesmus,	0	0	0	0	1	19	3	1	5	0	0	0
Staurogenia,	0	0	0	0	0	0	0	38	0	0	0	0
Fungi, Crenothrix,	**0**	**2**	**4**	**5**	**9**	**0**	**0**	**5**	**1**	**0**	**28**	**24**
ANIMALS.												
Infusoria,	**1**	**0**	**0**	**5**	**6**	**0**	**0**	**0**	**0**	**1**	**2**	**2**
Codonella,	0	0	0	0	0	0	0	0	0	0	2	0
Dinobryon cases,	0	0	0	2	3	0	0	0	0	0	0	0
Euglena,	0	0	0	2	0	0	0	0	0	0	0	0
Peridinium,	1	0	0	1	3	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	0	0	0	1	0	2
Miscellaneous, Zoöglœa,	**0**	**0**	**154**	**16**	**0**	**0**	**0**	**0**	**292**	**160**	**40**	**60**
Total,	17	7	162	37	79	204	639	470	916	514	76	104

BOSTON.

SUDBURY RIVER SUPPLY.— *Chemical Examination of Water from Walker's Brook, Marlborough.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13585	Jan. 2	Slight.	Cons.	0.20	13.65	3.00	.0240	.0144	.0112	.0032	1.98	.2900	.0034	.2117	5.6
13736	Feb. 4	Slight.	Cons.	0.50	12.90	3 05	.0380	.0224	.0200	.0024	1.81	.2000	.0018	.5056	4.6
13904	Mar. 4	Distinct, milky.	Cons., gray.	0.70	12.80	3.20	.0784	.0286	.0234	.0052	1.75	.1900	.0023	.7892	4.2
14058	Apr. 1	Slight.	Slight.	0.55	13.35	4.95	.0800	.0200	.0150	.0050	1.71	.2500	.0025	.5221	4.0
14218	May 1	Slight.	Cons.	0.70	13.90	4.70	.0310	.0440	.0290	.0150	1.88	.2400	.0020	.6660	4.6
14397	June 3	Distinct, milky.	Slight.	0.55	16.10	4.90	.0116	.0292	.0264	.0028	2.20	.1360	.0100	.5472	5.9
14558	July 1	Distinct, milky.	Slight.	0.65	17.10	2.35	.0240	.0248	.0228	.0020	2.46	.0830	.0050	.6038	5.9
14757	Aug. 1	Distinct, milky.	Slight.	0.55	16.40	2.00	.0080	.0312	.0256	.0056	2.30	.0830	.0030	.6240	5.9
14947	Sept. 2	Slight.	Slight.	0.18	14.80	3.40	.0000	.0152	.0142	.0010	2.20	.1000	.0048	.2680	5.3
15297	Oct. 1	Slight, milky.	Slight.	0.28	15.25	3.00	.0128	.0144	.0124	.0020	2.25	.1200	.0040	.2668	4.9
15460	Nov. 4	Distinct, clayey.	Cons., earthy.	1.10	17.00	6.15	.0212	.0386	.0338	.0048	2.10	.1800	.0015	1.1583	5.9
15674	Dec. 3	Distinct, clayey.	Slight, earthy.	0.90	13.30	4.80	.0220	.0242	.0224	.0018	1.82	.2500	.0017	.8073	4.4
Av.	....	....	....	0.57	14.71	3.79	.0292	.0256	.0214	.0042	2.04	.1768	.0035	.5808	5.1

Averages by Years.

-	1892	-	-	0.49	16.84	4.35	.0307	0274	.0225	.0048	2.58	.2975	.0037	-	5.7
-	1893	-	-	0.38	14.05	3.94	.0337	.0257	.0180	.0077	1.96	.1878	.0020	.3927	5.2
-	1894	-	-	0.46	14.14	3.62	.0371	.0217	.0171	.0046	2.08	.1888	.0018	.4701	4.9
-	1895	-	-	0.57	14.71	3.79	.0292	.0256	.0214	.0042	2.04	.1768	.0035	.5808	5.1

NOTE to analyses of 1895: Odor, distinctly vegetable or musty. —— The samples were collected from the brook, at the first road bridge below Maple Street, about a mile south of the centre of the city of Marlborough.

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Stony Brook, at Head of Reservoir No. 3, Southborough.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13569	Jan. 1	Slight.	Cons.	0.90	7.10	2.40	.0066	.0314	.0286	.0028	.64	.0320	.0002	0.7007	2.6
13745	Feb. 4	Slight.	Cons.	1.10	6.25	2.00	.0054	.0220	.0196	.0024	.51	.0300	.0001	1.1060	1.9
13913	Mar. 4	Slight.	Slight.	0.80	5.55	1.85	.0174	.0252	.0234	.0018	.45	.0380	.0002	0.7685	1.6
14066	Apr. 1	V. slight.	Slight.	0.80	4.30	1.70	.0002	.0234	.0212	.0022	.35	.0200	.0003	0.7469	1.4
14224	May 1	Slight.	Cons.	1.30	5.60	2.65	.0012	.0274	.0252	.0022	.42	.0220	.0003	1.1550	1.8
14406	June 3	Decided, brown	Cons., brown.	1.80	7.05	3.05	.0114	.0430	.0378	.0052	.42	.0120	.0008	1.9000	1.9
14561	July 1	Distinct.	Slight, brown.	1.25	7.95	2.30	.0014	.0368	.0328	.0040	.70	.0100	.0002	0.9298	2.2
14750	Aug. 1	Decided, green.	Cons., brown.	0.70	6.00	1.80	.0006	.0376	.0338	.0038	.40	.0050	.0000	0.7199	2.1
14954	Sept. 3	Distinct, milky.	Slight.	0.80	7.00	2.05	.0010	.0242	.0226	.0016	.54	.0050	.0003	0.6314	2.1
15288	Oct. 1	Decided, clayey.	Cons., earthy.	0.48	8.75	2.15	.0028	.0406	.0218	.0188	.52	.0150	.0004	0.4430	2.6
15468	Nov. 4	Distinct, clayey.	Slight, earthy.	1.50	7.55	3.40	.0006	.0400	.0338	.0062	.48	.0080	.0002	1.7004	2.2
15653	Dec. 2	Distinct, clayey.	Slight.	0.98	5.50	2.20	.0008	.0202	.0186	.0016	.39	.0380	.0002	0.9360	1.7
Av.	....	....	....	1.03	6.55	2.30	.0041	.0310	.0266	.0044	.49	.0196	.0003	0.9781	2.0

Averages by Years.

-	1887*	-	-	0.97	7.74	2.36	.0029	.0355	-	-	.74	.0152	-	-	-
-	1888	-	-	1.16	6.25	2.17	.0039	.0312	-	-	.51	.0303	.0004	-	-
-	1889	-	-	1.11	5.04	1.76	.0061	.0308	.0280	.0028	.50	.0275	.0005	-	-
-	1890	-	-	0.72	7.31	2.12	.0033	.0257	.0225	.0032	.56	.0262	.0003	-	2.4
-	1891	-	-	0.86	6.15	2.24	.0047	.0291	.0256	.0035	.59	.0226	.0003	-	2.0
-	1892	-	-	0.96	6.19	2.35	.0015	.0291	.0252	.0039	.49	.0202	.0002	-	1.9
-	1893	-	-	0.95	6.03	2.27	.0027	.0273	.0237	.0036	.50	.0127	.0002	.8254	2.0
-	1894	-	-	1.32	6.41	2.64	.0023	.0302	.0249	.0053	.49	.0151	.0001	1.0533	2.0
-	1895	-	-	1.03	6.55	2.30	.0041	.0310	.0266	.0044	.49	.0196	.0003	.9781	2.0

* June to December.

NOTE to analyses of 1895: Odor, generally distinctly vegetable, occasionally mouldy or unpleasant. —— The samples were collected from the brook, about 50 feet below the first road above Reservoir No. 3, at a depth of 1 foot beneath the surface.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 203.

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 3, Framingham.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13570	Jan. 1	V. slight.	Slight.	1.10	5.95	2.60	.0034	.0258	.0240	.0018	.48	.0130	.0001	.9317	2.2
13746	Feb. 4	V. slight.	V. slight.	1.00	5.80	1.95	.0048	.0226	.0194	.0032	.50	.0280	.0001	1.0665	1.9
13914	Mar. 4	V. slight.	V. slight.	0.88	6.20	2.25	.0056	.0200	.0180	.0020	.49	.0270	.0001	.8470	1.8
14067	Apr. 1	Slight.	Slight.	0.75	4.45	2.10	.0050	.0194	.0184	.0010	.34	.0240	.0003	.6506	1.4
14225	May 1	Slight.	Cons.	1.00	4.60	1.95	.0014	.0228	.0188	.0040	.37	.0230	.0002	.7969	1.4
14407	June 3	Distinct.	Slight, brown.	0.90	4.95	2.35	.0028	.0250	.0232	.0018	.39	.0130	.0002	.7904	1.7
14562	July 1	Distinct, green.	Slight, yellow.	0.80	4.85	1.65	.0000	.0304	.0210	.0094	.38	.0000	.0001	.7955	1.7
14751	Aug. 1	Decided, green.	Cons., brown.	0.65	5.85	2.10	.0004	.0302	.0256	.0046	.31	.0050	.0000	.7956	2.2
14955	Sept. 3	Decided, green.	Cons., yellow.	0.60	5.45	2.35	.0000	.0308	.0230	.0078	.45	.0030	.0001	.6737	1.8
15289	Oct. 1	Decided, green.	Slight, earthy.	0.45	5.10	2.25	.0020	.0410	.0308	.0102	.42	.0030	.0000	.6708	1.8
15469	Nov. 4	Distinct.	Slight, earthy.	1.05	6.20	2.65	.0042	.0326	.0304	.0022	.46	.0220	.0002	1.0920	1.9
15654	Dec. 2	Decided, clayey.	Slight.	1.15	5.80	2.40	.0024	.0268	.0246	.0022	.36	.0200	.0001	1.0179	1.7
Av.	....	....	....	0.86	5.43	2.22	.0027	.0273	.0231	.0042	.41	.0151	.0001	.8440	1.8

Averages by Years.

-	1887*	-	-	0.91	5.48	2.02	.0073	.0318	-	-	.43	.0170	-	-	-
-	1888	-	-	0.98	4.98	1.79	.0038	.0288	-	-	.40	.0218	.0003	-	-
-	1889	-	-	0.84	4.39	1.50	.0042	.0306	.0254	.0052	.42	.0182	.0003	-	-
-	1890	-	-	0.62	5.40	1.84	.0020	.0238	.0197	.0041	.40	.0229	.0002	-	2.0
-	1891	-	-	0.60	4.75	1.66	.0032	.0242	.0200	.0042	.38	.0190	.0002	-	1.7
-	1892	-	-	0.72	5.17	1.97	.0024	.0254	.0219	.0035	.40	.0211	.0001	-	1.8
-	1893	-	-	0.90	4.97	2.10	.0028	.0259	.0207	.0052	.37	.0100	.0001	.7681	1.7
-	1894	-	-	0.97	5.48	2.20	.0018	.0265	0231	.0034	.41	.0105	.0002	.8692	1.9
-	1895	-	-	0.86	5.43	2.22	.0027	.0273	.0231	.0042	.41	.0151	.0001	.8440	1.8

* June to December.

NOTE to analyses of 1895: Odor, vegetable and occasionally unpleasant, becoming somewhat stronger on heating. —— The samples were collected from the reservoir, near the gate-house, at a depth of 8 feet beneath the surface. For monthly record of height of water in this reservoir, see table at end of Boston analyses.

BOSTON.

SUDBURY RIVER SUPPLY. — *Microscopical Examination of Water from Reservoir No. 3, Framingham.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	6	3	2	5	2	3	5	2	6	3
Number of sample,	13570	13746	13914	14067	14225	14407	14562	14751	14955	15289	15469	15654
PLANTS.												
Diatomaceæ,	**128**	**4**	**1**	**7**	**408**	**624**	**431**	**539**	**252**	**1,089**	**671**	**169**
Asterionella,	114	0	0	3	160	79	1	10	4	660	468	140
Cyclotella,	8	0	0	1	5	47	312	308	72	72	2	3
Diatoma,	0	1	0	0	0	0	0	6	0	0	0	2
Fragilaria,	0	0	0	0	5	0	0	25	0	0	0	0
Melosira,	0	0	0	0	10	126	0	8	4	0	10	2
Meridion,	0	1	0	1	0	0	0	0	0	0	0	4
Stephanodiscus,	0	0	0	0	0	0	0	0	0	0	7	0
Synedra,	0	0	0	2	116	20	2	2	0	33	0	5
Tabellaria,	6	2	1	0	112	352	116	180	172	324	184	13
Cyanophyceæ,	**0**	**1**	**1**	**0**	**0**	**3**	**64**	**87**	**303**	**78**	**32**	**0**
Anabæna,	0	0	0	0	0	0	7	50	150	13	0	0
Clathrocystis,	0	0	0	0	0	0	29	1	0	7	2	0
Cœlosphærium,	0	1	1	0	0	0	0	32	150	55	30	0
Microcystis,	0	0	0	0	0	3	28	4	3	3	0	0
Algæ,	**0**	**0**	**0**	**0**	**1**	**45**	**469**	**116**	**10**	**55**	**124**	**4**
Chlorococcus,	0	0	0	0	0	0	0	0	8	3	6	0
Glœocapsa,	0	0	0	0	0	0	0	5	1	0	0	0
Pediastrum,	0	0	0	0	0	0	4	2	0	1	2	0
Protococcus,	0	0	0	0	1	24	464	32	0	33	0	0
Raphidium,	0	0	0	0	0	12	0	72	0	6	116	4
Scenedesmus,	0	0	0	0	0	8	0	0	0	0	0	0
Selenastrum,	0	0	0	0	0	0	0	0	0	10	0	0
Staurastrum,	0	0	0	0	0	1	1	5	1	2	0	0
Fungi, Crenothrix,	**0**	**2**	**3**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
ANIMALS.												
Infusoria,	**1**	**0**	**0**	**0**	**0**	**2**	**1**	**15**	**7**	**15**	**0**	**0**
Mallomonas,	0	0	0	0	0	2	0	0	1	2	0	0
Trachelomonas,	1	0	0	0	0	0	1	14	6	12	0	0
Vorticella,	0	0	0	0	0	0	0	1	0	1	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**11**	**9**	**0**	**116**	**0**	**0**	**0**	**0**	**0**	**100**
TOTAL,	129	7	16	20	409	790	965	757	572	1,237	827	277

BOSTON.

COCHITUATE SUPPLY. — *Chemical Examination of Water from Lake Cochituate, in Wayland.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13571	Jan. 1	Slight.	Cons.	.25	4.85	1.70	.0032	.0196	.0160	.0036	.52	.0070	.0000	.3542	2.2
13747	Feb. 4	V. slight.	Slight.	.28	5.40	1.30	.0024	.0170	.0146	.0024	.56	.0100	.0000	.4187	2.1
13915	Mar. 4	V. slight.	Cons.	.30	5.35	1.70	.0006	.0154	.0140	.0014	.56	.0220	.0000	.4697	2.3
14068	Apr. 1	V. slight.	Slight.	.30	5.20	1.95	.0010	.0192	.0160	.0032	.49	.0220	.0002	.4350	1.9
14226	May 1	Slight.	Slight.	.27	4.90	1.55	.0014	.0160	.0136	.0024	.48	.0200	.0002	.4196	2.1
14408	June 3	Slight.	Slight.	.27	5.10	2.30	.0026	.0168	.0148	.0020	.48	.0180	.0003	.4636	1.8
14563	July 1	Distinct.	Slight.	.25	4.80	1.60	.0014	.0184	.0154	.0030	.50	.0050	.0004	.4716	1.7
14752	Aug. 1	Slight.	Slight.	.25	5.40	1.55	.0002	.0166	.0150	.0016	.50	.0070	.0002	.4680	2.6
14956	Sept. 3	Slight.	Slight.	.18	5.20	1.50	.0002	.0184	.0158	.0026	.55	.0030	.0003	.4143	2.1
15290	Oct. 1	Slight.	Slight.	.20	5.00	1.50	.0010	.0198	.0184	.0014	.52	.0030	.0001	.3627	1.7
15483	Nov. 6	Decided.	Slight, green.	.22	4.70	1.65	.0010	.0176	.0140	.0036	.50	.0090	.0001	.3682	2.2
15655	Dec. 2	Decided.	Slight.	.22	5.10	1.85	.0034	.0182	.0158	.0024	.52	.0080	.0000	.4040	1.9
Av.	....	....	....	.25	5.08	1.68	.0015	.0178	.0153	.0025	.51	.0112	.0001	.4208	2.1

Averages by Years.

-	1887*	-	-	.21	5.08	1.38	.0017	.0186	-	-	.44	.0096	-	-	-
-	1888	-	-	.19	4.90	1.24	.0033	.0217	-	-	.43	.0127	.0003	-	-
-	1889	-	-	.33	5.08	1.62	.0025	.0210	.0177	.0033	.46	.0208	.0003	-	-
-	1890	-	-	.21	4.74	1.03	.0016	.0184	.0149	.0035	.49	.0206	.0003	-	2.4
-	1891	-	-	.24	4.66	1.44	.0017	.0182	.0145	.0037	.42	.0212	.0002	-	1.8
-	1892	-	-	.15	4.61	1.35	.0018	.0168	.0133	.0035	.48	.0152	.0001	-	2.0
-	1893	-	-	.21	4.64	1.58	.0015	.0168	.0138	.0030	.46	.0098	.0002	.3925	2.0
-	1894	-	-	.20	4.76	1.59	.0008	.0163	.0137	.0026	.51	.0070	.0001	.3699	2.1
-	1895	-	-	.25	5.08	1.68	.0015	.0178	.0153	.0025	.51	.0112	.0001	.4208	2.1

* June to December.

NOTE to analyses of 1895: Odor, generally vegetable, sometimes none, becoming stronger and sometimes unpleasant on heating. —— The samples were collected in the gate-house. For monthly record of height of water in this lake, see table at end of Boston analyses.

BOSTON.

COCHITUATE SUPPLY. — *Microscopical Examination of Water from Lake Cochituate, in Wayland.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	6	3	2	5	2	3	5	2	7	3
Number of sample,	13571	13747	13915	14068	14226	14408	14563	14752	14956	15290	15483	15655
PLANTS.												
Diatomaceæ,	1,168	34	53	73	847	11	55	190	5	161	1,152	2,154
Asterionella,	1,080	22	33	68	184	8	7	0	0	61	1,028	1,780
Cyclotella,	24	2	0	pr.	1	0	32	176	5	0	0	32
Fragilaria,	0	0	3	0	2	0	15	5	0	94	0	0
Melosira,	55	7	6	2	543	0	0	0	0	0	112	232
Stephanodiscus,	0	0	0	0	0	0	0	0	0	0	4	32
Synedra,	pr.	2	8	3	96	3	1	9	0	2	0	2
Tabellaria,	9	1	3	pr.	16	0	0	0	0	4	8	76
Cyanophyceæ,	0	68	0	0	0	74	105	62	12	13	454	371
Anabæna,	0	0	0	0	0	0	6	2	4	0	0	1
Clathrocystis,	0	0	0	0	0	0	11	0	0	0	0	0
Microcystis,	0	0	0	0	0	74	88	60	8	13	2	2
Oscillaria,	0	68	0	0	0	0	0	0	0	0	452	368
Algæ,	0	0	0	0	0	141	1,720	572	259	46	500	0
Chlorococcus,	0	0	0	0	0	0	0	0	18	1	0	0
Glœocapsa,	0	0	0	0	0	0	0	0	3	0	500	0
Protococcus,	0	0	0	0	0	141	1,720	500	26	45	0	0
Raphidium,	0	0	0	0	0	0	0	72	212	0	0	0
Fungi, Crenothrix,	0	3	1	1	0	1	0	0	0	0	5	0
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	0	0	0	0	0	0	0	2
Infusoria,	5	3	2	2	12	0	0	0	1	17	8	38
Dinobryon,	0	0	0	pr.	0	0	0	0	0	0	3	0
Dinobryon cases,	3	0	0	2	3	0	0	0	0	14	0	0
Mallomonas,	1	0	0	pr.	1	0	0	0	1	2	4	6
Peridinium,	1	0	0	0	4	0	0	0	0	0	0	0
Synura,	pr.	1	0	0	1	0	0	0	0	0	0	24
Trachelomonas,	pr.	2	2	pr.	2	0	0	0	0	1	1	7
Vorticella,	pr.	0	0	0	1	0	0	0	0	0	0	1
Crustacea, Cyclops,	.01	0	0	0	.04	0	0	.02	0	0	0	0
Miscellaneous, Zoöglœa,	0	15	0	0	0	0	0	0	0	0	5	20
TOTAL,	1,173	123	56	76	859	227	1,880	824	277	237	2,124	2,585

BOSTON.

COCHITUATE WORKS. — *Chemical Examination of Water from a Faucet at the Massachusetts Institute of Technology, Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13572	Jan. 1	V.slight.	V.slight.	1.10	5.15	2.30	.0022	.0246	.0210	.0036	.43	.0100	.0000	.7892	1.9
13750	Feb. 5	V.slight.	V.slight.	0.80	6.00	1.95	.0010	.0190	.0176	.0014	.46	.0250	.0000	.9085	2.1
13916	Mar. 4	V.slight.	V.slight.	0.80	5.75	2.20	.0016	.0180	.0154	.0026	.47	.0230	.0000	.7892	1.8
14069	Apr. 1	Slight.	V.slight.	0.60	5.05	1.90	.0010	.0172	.0160	.0012	.42	.0300	.0001	.5505	1.8
14227	May 1	V.slight.	Slight.	0.60	4.55	1.85	.0006	.0174	.0156	.0018	.38	.0270	.0001	.5736	1.9
14409	June 3	Slight.	Slight.	0.60	4.85	2.30	.0000	.0176	.0162	.0014	.42	.0200	.0001	.5548	1.7
14564	July 1	Distinct.	Slight.	0.60	4.80	2.15	.0000	.0198	.0180	.0018	.39	.0150	.0001	.6038	1.6
14753	Aug. 1	Slight.	Slight.	0.60	4.55	1.70	.0000	.0216	.0198	.0018	.36	.0100	.0001	.6474	1.8
14957	Sept. 3	Distinct.	Slight.	0.58	4.50	1.95	.0000	.0176	.0138	.0038	.41	.0080	.0003	.5698	1.4
15291	Oct. 1	Slight.	Slight.	0.48	4.20	1.55	.0002	.0214	.0176	.0038	.33	.0050	.0000	.5538	1.3
15470	Nov. 4	Slight.	Slight.	0.90	5.10	2.55	.0000	.0220	.0202	.0018	.40	.0120	.0002	.8892	1.6
15656	Dec. 2	Slight.	Slight.	0.93	4.25	1.80	.0008	.0202	.0190	.0012	.36	.0200	.0000	.8463	1.7
Av.	....	....	....	0.72	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.6897	1.7

Averages by Years.

-	1887*	-	-	0.35	4.89	1.37	.0002	.0225	-	-	.41	.0094	-	-	-
-	1888	-	-	0.38	4.94	1.53	.0012	.0215	-	-	.40	.0183	.0002	-	-
-	1889	-	-	0.51	4.71	1.43	.0005	.0199	.0176	.0023	.42	.0272	.0002	-	-
-	1890	-	-	0.35	4.70	1.25	.0003	.0169	.0148	.0021	.42	.0241	.0001	-	2.2
-	1891	-	-	0.37	4.39	1.63	.0005	.0161	.0136	.0025	.37	.0227	.0001	-	1.7
-	1892	-	-	0.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
-	1893	-	-	0.61	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.5976	1.8
-	1894	-	-	0.69	4.14	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.6295	1.7
-	1895	-	-	0.72	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.6897	1.7

* June to December.

NOTE to analyses of 1895: Odor, generally faintly vegetable, rarely none.

BOSTON.

COCHITUATE WORKS. — *Microscopical Examination of Water from a Faucet at the Massachusetts Institute of Technology, Boston.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	6	3	2	5	2	3	5	2	6	3
Number of sample,	13572	13750	13916	14069	14227	14409	14564	14753	14957	15291	15470	15656
PLANTS.												
Diatomaceæ,	**149**	**24**	**8**	**14**	**113**	**59**	**415**	**104**	**328**	**51**	**479**	**270**
Asterionella,	124	20	6	12	57	2	12	0	0	0	325	200
Cyclotella,	3	0	0	0	0	1	108	36	56	8	5	2
Fragilaria,	0	0	0	0	0	0	0	0	10	0	0	0
Melosira,	6	0	0	0	35	27	1	0	0	0	8	60
Synedra,	0	2	1	1	8	5	2	36	6	1	9	0
Tabellaria,	16	2	1	1	13	24	292	32	256	42	132	8
Cyanophyceæ,	**5**	**0**	**pr.**	**0**	**0**	**0**	**28**	**3**	**6**	**1**	**11**	**44**
Microcystis,	0	0	0	0	0	0	28	3	6	1	0	0
Oscillaria,	5	0	pr.	0	0	0	0	0	0	0	11	44
Algæ,	**0**	**0**	**0**	**0**	**0**	**95**	**300**	**230**	**12**	**0**	**1**	**2**
Protococcus,	0	0	0	0	0	95	300	228	8	0	0	0
Raphidium,	0	0	0	0	0	0	0	2	4	0	1	2
Fungi, Crenothrix,	**0**	**0**	**4**	**pr.**	**2**	**0**	**0**	**2**	**7**	**1**	**0**	**0**
ANIMALS.												
Infusoria,	**pr.**	**4**	**0**	**0**	**5**	**0**	**1**	**4**	**5**	**1**	**1**	**6**
Dinobryon cases,	0	4	0	0	5	0	0	4	5	1	0	0
Mallomonas,	pr.	0	0	0	0	0	0	0	0	0	1	1
Trachelomonas,	0	0	0	0	0	0	1	0	0	0	0	5
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**27**	**0**	**0**	**0**
TOTAL,	154	28	12	14	120	154	744	343	385	54	492	322

BOSTON.

MYSTIC SUPPLY. — *Chemical Examination of Water from Mystic Lake.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13561	Jan. 1	Slight.	Slight.	.05	21.20	3.40	.1040	.0220	.0200	.0020	5.32	.0680	.0016	.2194	7.4
13739	Feb. 4	Slight.	Slight.	.12	18.90	2.40	.1000	.0290	.0240	.0050	3.60	.0920	.0022	.3215	6.4
13877	Feb. 21	Slight.	Slight.	.20	18.20	3.00	.0920	.0210	.0200	.0010	2.70	.0850	.0024	.3783	6.1
13917	Mar. 4	Distinct.	V. slight.	.08	21.40	3.20	.1360	.0310	.0220	.0090	4.20	.1150	.0020	.2579	7.0
14056	Apr. 1	Distinct.	Slight.	.20	13.10	2.80	.0840	.0370	.0280	.0090	2.39	.1000	.0020	.3041	4.4
14236	May 2	Distinct.	Slight.	.18	13.80	3.85	.0720	.0180	.0120	.0060	2.52	.0930	.0017	.3696	4.9
14396	June 3	Distinct, milky.	Slight.	.18	14.80	3.70	.0560	.0340	.0260	.0080	2.44	.0600	.0020	.3534	5.0
14555	July 1	Distinct.	Slight.	.12	14.35	2.10	.0132	.0228	.0176	.0052	2.66	0370	.0015	.2820	4.9
14741	Aug. 1	Distinct.	Cons.	.10	15.85	3.25	.0076	.0276	.0196	.0080	3.00	.0150	.0013	.4004	5.3
14946	Sept. 3	Distinct, green.	Slight, green.	.15	15.65	2.25	.0008	.0360	.0212	.0148	3.50	.0080	.0010	.3195	4.9
15277	Oct. 1	Decided, green.	Slight, green.	.15	15.35	2.55	.0000	.0324	.0200	.0124	3.60	.0170	.0009	.2714	4.9
15458	Nov. 4	Distinct, brown.	Slight, brown.	.15	15.80	3.25	.0236	.0124	.0104	.0020	3.55	.0400	.0014	.3159	5.4
15645	Dec. 2	Distinct.	Slight.	.30	13.00	2.50	.0670	.0270	.0180	.0090	2.65	.0600	.0012	.4306	4.6
Av.*	....	....	....	.15	16.07	2.96	.0550	.0271	.0197	.0074	3.25	.0585	.0016	.3228	5.4

Averages by Years.

-	1887†	-	-	.28	10.82	1.62	.0114	.0266	-	-	2.06	.0263	-	-	-
-	1888	-	-	.21	10.12	1.76	.0244	.0267	-	-	1.94	.0433	.0016	-	-
-	1889	-	-	.26	9.02	1.97	.0211	.0278	.0209	.0069	1.67	.0586	.0012	-	-
-	1890	-	-	.13	10.65	1.78	.0197	.0223	.0183	.0040	1.57	.0796	.0008	-	3.7
-	1891	-	-	.13	9.50	1.81	.0186	.0242	.0187	.0055	1.58	.0731	.0012	-	3.5
-	1892	-	-	.07	11.52	2.09	.0185	.0206	.0153	.0053	2.22	.0698	.0007	-	4.1
-	1893	-	-	.10	12.62	2.17	.0240	.0215	.0159	.0056	2.49	.0583	.0007	-	4.4
-	1894	-	-	.11	15.60	2.56	.0381	.0235	.0168	.0067	3.48	.0583	.0012	.2608	5.2
-	1895	-	-	.15	16.07	2.96	.0550	.0271	.0197	.0074	3.25	.0585	.0016	.3228	5.4

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† June to December.

NOTE to analyses of 1895: Odor, generally unpleasant or disagreeable; in February and March, offensive. The odor was generally stronger on heating.——The samples were collected from the lake, near the gate-house. For monthly record of height of water in this lake, see table at end of Boston analyses.

BOSTON.

MYSTIC SUPPLY. — *Microscopical Examination of Water from Mystic Lake.*

[Number of organisms per cubic centimeter.]

	1895.												
	Jan.	Feb	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	5	23	6	2	4	3	1	2	4	2	5	3
Number of sample,	13561	13739	13877	13917	14056	14236	14396	14555	14741	14946	15277	15458	15645
PLANTS.													
Diatomaceæ,	**1,104**	**43**	**1**	**6**	**2**	**230**	**177**	**6,817**	**4,006**	**1,963**	**1,816**	**1,301**	**527**
Asterionella,	0	28	0	2	0	112	2	0	0	0	0	0	0
Fragilaria,	4	0	0	0	0	3	0	0	6	3	16	0	0
Melosira,	0	0	0	0	0	6	0	15	0	0	0	0	7
Navicula,	0	0	0	1	1	5	1	2	0	0	0	1	0
Synedra,	1,100	15	1	3	1	104	174	6,800	4,000	1,960	1,800	1,300	520
Algæ,	**69**	**4**	**1**	**1**	**5**	**140**	**670**	**148**	**440**	**1,740**	**568**	**224**	**18**
Closterium,	0	0	0	0	0	0	22	0	0	0	0	0	0
Pediastrum,	0	0	0	0	0	0	0	0	0	1,220	0	0	0
Protococcus,	0	0	0	0	0	21	534	0	0	0	0	0	3
Raphidium,	0	0	0	0	0	45	0	0	0	0	4	0	0
Scenedesmus,	68	3	0	0	4	56	113	148	440	520	564	224	14
Zoöspores,	1	1	1	1	1	18	1	0	0	0	0	0	1
Fungi, Crenothrix,	**5**	**3**	**52**	**76**	**0**	**15**	**52**	**0**	**0**	**0**	**0**	**0**	**44**
ANIMALS.													
Infusoria,	**2**	**1**	**3**	**3**	**9**	**22**	**0**	**0**	**116**	**0**	**225**	**0**	**8**
Ciliated infusorian,	0	0	1	1	0	0	0	0	0	0	0	0	0
Dinobryon,	0	0	0	0	4	0	0	0	0	0	0	0	0
Dinobryon cases,	0	0	0	0	0	5	0	0	0	0	0	0	0
Euglena,	0	1	0	0	1	0	0	0	0	0	0	0	0
Monas,	1	0	1	1	1	0	0	0	0	0	1	0	0
Peridinium,	1	0	0	1	2	0	0	0	116	0	224	0	0
Trachelomonas,	0	0	1	0	1	0	0	0	0	0	0	0	0
Vorticella,	0	0	0	0	0	8	0	0	0	0	0	0	8
Vorticella stems,	0	0	0	0	0	9	0	0	0	0	0	0	0
Vermes, Anurea,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**
Miscellaneous, Zoöglœa,	**5**	**600**	**76**	**1,160**	**224**	**180**	**0**	**0**	**0**	**0**	**0**	**200**	**100**
TOTAL,	1,185	651	133	1,246	240	587	899	6,967	4,562	3,704	2,609	1,725	697

BOSTON.

MYSTIC SUPPLY. — *Chemical Examination of Water from a Faucet in the Charlestown District of Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
13876	1895. Feb. 21	Slight.	Slight.	.10	20.70	2.90	.1120	.0190	.0150	.0040	3.85	.0850	.0030	.2457	6.7

Odor, decidedly musty and very disagreeable. —— The sample was collected at the State Prison.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 5; *Synedra*, 17. Algæ, *Zoöspores*, 3. Fungi, *Crenothrix*, 68. Infusoria, *Ciliated Infusorian*, 1. Miscellaneous, *Zoöglœa*, 184. Total, 278.

Table showing the Heights in Feet above Tide-marsh Level on the First of Each Month of the Water in the Lakes and Storage Reservoirs of the Boston Water Works, from which Samples of Water were collected during the Year 1895.

1895.	Reservoir No. 2. Flash Boards, 167.12.	Reservoir No. 3. Stone Crest, 175.24.	Reservoir No. 4. Flash Boards, 215.21.	Reservoir No. 6. Flash Boards, 295.00.	Farm Pond. High Water, 149.25.	Lake Cochituate. High Water, 134.36.	Mystic Lake. High Water, 7 00.
Jan. 1, .	166.00	175.24	196.18	278.84	148.79	126.28	3.37
Feb. 1, .	166.05	175.45	201.65	283.48	149.06	126.90	4.38
March 1, .	161.22	172.47	203.79	285.21	149.01	126.50	3.18
April 1, .	166.16	175.66	212.91	293.42	149.35	132.97	6.47
May 1, .	166.09	175.37	214.60	294.28	149.63	134.35	6.48
June 1, .	166.05	174.68	215.34	295.02	149.32	134.04	6.80
July 1, .	164.23	169.46	215.31	295.04	149.01	133.09	4.67
Aug. 1, .	163.97	170.47	210.25	290.58	149.00	131.72	4.20
Sept. 1, .	163.30	172.50	203.98	283.91	148.89	130.20	5.87
Oct. 1, .	163.14	172.57	194.41	273.64	148.58	128.98	3.28
Nov. 1, .	167.15	175.66	197.35	279.19	149.27	129.63	6.75
Dec. 1, .	166.23	175.77	207.83	289.92	149.36	132.71	6.28

WATER SUPPLY OF BRADFORD.

The advice of the State Board of Health to the Bradford Water Company, relative to the introduction of a new supply from Johnson's Pond in Boxford and Groveland and as to the improvement of the existing supply, is given on pages 15 and 16 of this volume. Analyses of samples of water from Johnson's Pond may be found on page 164 of the annual report for 1894.

The works of the Bradford Water Company were taken by the town of Bradford on April 1, 1895, and works for the introduction of a new supply from Johnson's Pond were partially constructed at the end of 1895, but as yet no water has been supplied to the town from this source.

BRADFORD.

The rapid deterioration of the water of the wells from which the supply is drawn, which has been referred to in the last two annual reports, continued during 1895, as shown by the table of yearly averages of analyses of water from this source, which is given at the bottom of this page.

Chemical Examination of Water from the Wells of the Bradford Water Works.

[Parts per 100,000]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13634	Jan. 9	Decided, milky.	Slight.	.60	5.60	.0524	.0048	.29	.0180	.0000	.1209	2.3	.1900
13771	Feb. 6	Decided.	Heavy, yellow.	.28	6.40	.0584	.0116	.31	.0120	.0000	.1777	1.9	.2800
13927	Mar. 5	Decided.	Cons., yellow.	.80	4.90	.0488	.0058	.33	.0150	.0000	.1401	2.1	.2450
14087	April 3	Decided.	Cons., rusty, floc.	.45	5.90	.0190	.0016	.31	.0280	.0001	.1155	2.5	.1650
14254	May 7	Distinct, milky.	Cons., floc.	.03	5.60	.0402	.0036	.34	.0270	.0002	.0616	2.5	.1000
14429	June 5	Distinct, iron.	Cons., rusty.	.08	6.30	.0476	.0112	.32	.0150	.0002	.0988	2.1	.2350
14596	July 10	Decided, milky.	Slight, rusty.	.60	5.20	.0540	.0044	.27	.0130	.0007	.1343	2.2	.0900
14779	Aug. 7	Decided, milky.	Slight, rusty.	.38	6.60	.0520	.0064	.25	.0150	.0006	.1404	3.1	.2400
15187	Sept. 17	Decided, rusty.	Cons., rusty.	.40	7.30	.0546	.0098	.36	.0130	.0006	.2067	2.7	.2600
15323	Oct. 8	Decided, milky.	Cons., iron.	.73	6.00	.0644	.0032	.37	.0070	.0003	.2246	2.6	.2500
15489	Nov. 7	Decided, milky.	Slight, rusty.	.70	5.90	.0984	.0056	.35	.0120	.0007	.1443	2.3	.2400
15686	Dec. 5	Decided, rusty.	Slight, rusty.	.90	5.80	.0732	.0084	.27	.0100	.0008	.1989	2.3	.3700
Av.	....	....	....	.50	5.96	.0552	.0064	.31	.0154	.0003	.1470	2.4	.2221

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1889*	-	-	.00	3.95	.0000	.0014	.21	.0400	.0000	-	1.6	-
-	1890†	-	-	.00	5.30	.0002	.0036	.34	.0150	.0001	-	2.6	-
-	1891‡	-	-	.04	5.40	.0000	.0027	.23	.0350	.0001	-	1.8	-
-	1892	-	-	.03	6.59	.0262	.0029	.28	.0760	.0003	-	2.4	-
-	1893	-	-	.33	5.80	.0297	.0047	.30	.0475	.0008	.0994	2.5	.0774
-	1894	-	-	.43	6.08	.0409	.0056	.28	.0244	.0008	.1225	2.4	.1453
-	1895	-	-	.50	5.96	.0552	.0064	.31	.0154	.0003	.1470	2.4	.2221

* July. † October. ‡ April, two samples.

NOTE to analyses of 1895: Odor, generally none, sometimes distinct. —— Nos. 13927 and 14087 were collected from a faucet at the pumping station and the others from faucets in the town.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 61, chiefly *Crenothrix*.

Water Supply of Braintree.

In August, September and October the water from the Braintree filter-gallery was affected by the presence of an excessive amount of iron, as will be seen by reference to the analyses in the table below. The iron oxidizes on exposure to the air and precipitates, causing first a milky turbidity and then a rusty precipitate. Information as to the effect of the presence of iron in ground waters may be found in the explanatory note on page 75.

Chemical Examination of Water from the Filter-gallery of the Braintree Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13607	Jan. 7	None.	V. slight.	.07	6.10	.0000	.0070	1.01	.0780	.0000	.0936	2.2	.0020
13777	Feb. 7	None.	V. slight.	.08	5.35	.0004	.0086	0.94	.0630	.0000	.1935	2.1	.0060
13932	Mar. 6	None.	None.	.03	5.35	.0002	.0062	0.94	.0480	.0000	.1555	1.7	.0025
14089	Apr. 3	None.	None.	.12	4.75	.0000	.0068	0.83	.0470	.0000	.1963	1.7	.0100
14253	May 7	None.	None.	.15	4.90	.0000	.0078	0.82	.0270	.0000	.2002	1.4	.0030
14434	June 5	None.	None.	.04	5.05	.0004	.0074	0.85	.0350	.0000	.1315	1.7	.0045
14613	July 11	V. slight.	V. slight.	.18	4.70	.0018	.0070	0.80	.0130	.0016	.1659	1.3	.0150
14790	Aug. 8	None.	V. slight.	.20	5.35	.0004	.0040	0.84	.0070	.0001	.1092	2.9	.0650
14997	Sept. 5	Slight, milky.	Cons., rusty.	.02	5.40	.0010	.0060	0.82	.0020	.0004	.0936	1.6	.2150
15312	Oct. 7	Distinct.	Slight.	.48	5.00	.0002	.0030	0.89	.0030	.0002	.1014	1.9	.1600
15486	Nov. 6	None.	None.	.05	6.25	.0002	.0040	1.00	.0400	.0002	.0858	2.1	.0050
15680	Dec. 4	None.	V. slight.	.05	5.70	.0006	.0042	0.97	.0790	.0000	.0717	2.9	.0130
Av.	....	....	....	.12	5.32	.0004	.0060	0.89	.0369	.0002	.1332	2.0	.0417

Averages by Years.

-	-*	-	-	.07	7.14	.0006	.0045	0.85	.0948	.0003	-	-	-
-	1892	-	-	.02	4.69	.0002	.0030	0.75	.0192	.0001	-	1.8	-
-	1893	-	-	.03	4.72	.0002	.0049	0.83	.0363	.0001	.1029	1.8	.0037
-	1894	-	-	.04	5.19	.0004	.0048	0.86	.0338	.0001	.1000	1.7	.0135
-	1895	-	-	.12	5.32	.0004	.0060	0.89	.0369	.0002	.1332	2.0	.0417

* June, 1887, to May, 1888.

Note to analyses of 1895: Odor, in January and July, distinctly vegetable; in February and October, faintly earthy; in November, faintly sweetish; at other times, none. In January and November the odor disappeared on heating.——The samples were collected from a faucet at the pumping station.

BRAINTREE.

Microscopical Examination of Water from the Filter-gallery of the Braintree Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb	Mar	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	8	7	8	4	8	7	12	10	7	8	8	5
Number of sample,	13607	13777	13932	14089	14253	14434	14613	14790	14997	15312	15486	15680
PLANTS.												
Diatomaceæ, Asterionella,	0	0	0	0	0	0	0	0	0	0	8	0
Fungi, Crenothrix,	2	0	5	0	0	0	400	110	40	52	10	2
ANIMALS.												
Infusoria, Trachelomonas,	0	1	0	0	pr.	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	0	15	0	0	0	0	0	0	0	62	0
TOTAL,	2	1	20	0	pr.	0	400	110	40	52	80	2

Water Supply of Bridgewater and East Bridgewater. — Bridgewaters Water Company.

During the year 1895 nine tubular wells, each 6 inches in diameter, were added to the works. These wells are located about 1,000 feet east of the pumping station, in a line at right angles to the course of the river, and are about 200 feet apart in the line. They are from 90 to 165 feet in depth and are sunk in rock, the surface of which is from 30 to 50 feet beneath the surface of the ground. An analysis of a sample of water from one of the wells, which is 160 feet deep, is given on the following page.

Chemical Examination of Water from the Wells of the Bridgewaters Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14595	1895. July 10	V. slight.	V. slight.	.00	4.35	.0008	.0002	.43	.0130	.0000	.0237	1.1	.0110

Odor, none. —— The sample was collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

BRIDGEWATER AND EAST BRIDGEWATER.

Chemical Examination of Water from a New Tubular Well of the Bridgewaters Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
14390	1895. May 30	Slight, milky.	None.	.20	10.90	.0014	.0006	.36	.0040	.0000	.0076	4.0	.0680

Odor, none. —— The sample was collected from a new tubular well 160 feet in depth and located about 1,000 feet east of the pumping station.

Microscopical Examination.

No organisms.

Water Supply of Brockton.

Chemical Examination of Water from Salisbury Brook Storage Reservoir, Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13620	Jan. 7	V. slight.	V. slight.	1.00	4.80	2.15	.0002	.0268	.0228	.0040	.48	.0000	.0000	.8658	1.3
13955	Mar. 11	Slight.	Slight.	0.70	3.85	1.70	.0002	.0224	.0170	.0054	.41	.0000	.0000	.7130	0.9
14110	Apr. 8	Slight.	Slight.	0.58	3.85	1.60	.0012	.0210	.0196	.0014	.38	.0020	.0000	.5513	0.8
14262	May 8	Slight.	Cons.	0.80	3.05	1.75	.0006	.0192	.0170	.0022	.38	.0000	.0000	.6314	0.5
14442	June 10	Distinct.	Cons.	0.90	3.30	1.95	.0000	.0260	.0240	.0020	.39	.0030	.0000	.7752	0.8
14618	July 15	Distinct.	Cons.	0.90	3.70	1.90	.0006	.0276	.0244	.0032	.42	.0050	.0000	.8346	0.6
14807	Aug. 12	Distinct.	Slight.	0.75	3.80	2.00	.0004	.0296	.0230	.0066	.46	.0030	.0001	.7176	1.4
15107	Sept. 9	Distinct.	Slight.	0.67	3.50	1.70	.0000	.0298	.0230	.0068	.46	.0000	.0000	.6240	1.3
15327	Oct. 8	Distinct.	Slight.	0.52	3.20	1.60	.0000	.0280	.0244	.0036	.48	.0000	.0000	.5444	0.8
15517	Nov. 12	Slight.	Slight.	0.93	4.05	2.20	.0044	.0348	.0284	.0064	.48	.0070	.0000	.9321	0.8
15691	Dec. 9	V. slight	Slight.	1.10	4.10	1.95	.0018	.0236	.0228	.0008	.35	.0000	.0000	.9516	0.8
Av.	....	....	....	0.80	3.75	1.86	.0009	.0263	.0224	.0039	.43	.0018	.0000	.7401	0.9

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1887*	-	-	0.99	4.94	2.25	.0033	.0541	-	-	.33	.0069	-	-	-
-	1888	-	-	0.76	3.77	1.61	.0031	.0369	-	-	.31	.0066	.0001	-	-
-	1889	-	-	0.78	2.79	1.01	.0028	.0306	.0218	.0078	.30	.0048	.0002	-	-
-	1890	-	-	0.75	4.07	1.98	.0016	.0274	.0219	.0055	.32	.0063	.0001	-	0.9
-	1891	-	-	0.62	3.15	1.45	.0010	.0213	.0169	.0044	.28	.0061	.0001	-	0.6
-	1892	-	-	0.55	3.41	1.37	.0004	.0213	.0168	.0045	.36	.0030	.0000	-	0.7
-	1893	-	-	0.67	3.59	1.70	.0007	.0237	.0196	.0041	.40	.0019	.0001	.6545	0.7
-	1894	-	-	0.81	3.71	1.63	.0012	.0228	.0188	.0040	.44	.0021	.0000	.6638	0.7
-	1895	-	-	0.80	3.75	1.86	.0009	.0263	.0224	.0039	.43	.0018	.0000	.7401	0.9

* June to December.

NOTE to analyses of 1895: Odor, vegetable, frequently becoming somewhat stronger on heating. —— The samples were collected from the reservoir near the gate-house, 1 foot beneath the surface. For monthly record of height of water in this reservoir, see page 125.

BROCKTON.

Microscopical Examination of Water from Salisbury Brook Storage Reservoir, Brockton.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	8	13	9	9	11	16	13	11	9	13	10
Number of sample,	13620	13955	14110	14262	14442	14618	14807	15107	15327	15517	15691
PLANTS.											
Diatomaceæ,	0	10	50	318	3,352	2,105	769	155	1,855	327	93
Asterionella,	0	0	2	16	856	332	4	29	76	0	9
Diatoma,	0	0	1	0	0	0	0	0	6	0	0
Melosira,	0	0	21	22	16	11	0	19	61	33	4
Synedra,	0	1	0	0	0	2	1	7	900	2	8
Tabellaria,	0	9	26	280	2,480	1,760	764	100	812	292	72
Cyanophyceæ, Microcystis,	0	0	0	0	0	0	0	7	0	0	1
Algæ,	0	0	1	55	12	5	21	37	80	11	14
Conferva,	0	0	1	2	0	0	0	0	0	3	1
Protococcus,	0	0	0	34	0	0	14	0	0	0	8
Raphidium,	0	0	0	0	8	4	4	0	14	6	3
Scenedesmus,	0	0	0	13	0	0	1	1	2	2	2
Selenastrum,	0	0	0	0	0	0	0	0	10	0	0
Staurastrum,	0	0	0	0	4	1	2	36	36	0	0
Zoöspores,	0	0	0	6	0	0	0	0	18	0	0
Fungi, Crenothrix,	0	5	0	2	0	0	0	0	0	0	0
ANIMALS.											
Rhizopoda, Difflugia,	0	0	0	0	2	0	0	0	0	0	0
Infusoria,	91	132	16	4,440	16	4	15	5	8	9	7
Ciliated infusorian,	0	2	0	0	0	0	0	0	0	0	0
Codonella,	0	0	0	0	0	0	0	0	4	0	0
Dinobryon,	15	0	0	64	0	0	0	0	0	0	0
Dinobryon cases,	0	26	1	4,368	10	0	0	0	0	0	0
Mallomonas,	0	0	0	2	0	0	0	0	1	0	0
Peridinium,	76	104	15	6	4	2	3	5	0	9	7
Trachelomonas,	0	0	0	0	2	2	12	0	3	0	0
Vermes,	0	3	0	3	2	3	1	4	0	1	0
Anurea,	0	0	0	0	0	2	1	2	0	1	0
Polyarthra,	0	0	0	2	0	0	0	0	0	0	0
Rotatorian ova,	0	1	0	1	0	1	0	2	0	0	0
Rotifer,	0	2	0	0	2	0	0	0	0	0	0
Crustacea,	0	0	0	1	0	.04	.04	0	0	0	0
Cyclops,	0	0	0	0	0	.04	.04	0	0	0	0
Crustacean remains,	0	0	0	1	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	0	96	72	0	0	0	160	0	40	40
TOTAL,	91	150	163	4,891	3,384	2,117	806	368	1,943	388	155

BROCKTON.

Table showing Height of Water in Salisbury Brook Storage Reservoir, Brockton, on the First Day of Each Month in 1895.

[NOTE. — High-water mark is 14.25 feet.]

DATE.	Height of Water.	DATE.	Height of Water.
1895.	Feet.	1895.	Feet.
Jan. 1,	14.75	July 1,	13.87
Feb. 1,	14.84	Aug. 1,	13.04
March 1,	14.33	Sept. 1,	11.58
April 1,*	14.54	Oct. 1,	10.35
May 1,	15.58	Nov. 1,	13.50
June 1,	15.33	Dec. 1,	14.79

* About April 1, 1895, the water was raised temporarily 18 inches above high-water mark.

WATER SUPPLY OF BROOKFIELD.

The advice of the State Board of Health to the town of Brookfield, relative to taking an additional supply of water from South Pond in that town, may be found on pages 16 and 17 of this volume. Analyses of samples of water collected during the investigation for an additional supply are given below.

Chemical Examination of Water from South Pond, Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13994	Mar. 18	V. slight.	Cons.	.28	3.30	0.80	.0036	.0168	.0154	.0014	.19	.0000	.0000	.3002	1.9
14361	May 23	Slight.	Slight.	.05	2.40	0.60	.0000	.0122	.0108	.0014	.19	.0000	.0000	.1520	0.8
14385	May 29	Slight.	Slight.	.05	2.95	1.10	.0000	.0104	.0072	.0032	.18	.0000	.0000	.1558	0.9

Odor, vegetable. —— The first sample was collected from the pond, at the outlet; the second, near the Point of Pines; the third, at the deepest part near the centre.

BROOKFIELD.

Microscopical Examination of Water from South Pond, Brookfield.

[Number of organisms per cubic centimeter.]

	1895. March.	1895. May.	1895. May.
Day of examination,	19	25	31
Number of sample,	13994	14361	14385
PLANTS.			
Diatomaceæ,	**37**	**221**	**259**
Amphipleura,	0	3	0
Asterionella,	8	8	42
Cyclotella,	3	44	128
Diatoma,	2	5	0
Fragilaria,	2	4	0
Melosira,	2	5	0
Navicula,	1	4	0
Pinnularia,	0	2	1
Synedra,	2	2	4
Tabellaria,	17	144	84
Cyanophyceæ, Anabæna,	**0**	**0**	**8**
Fungi, Crenothrix,	**3**	**0**	**0**
ANIMALS.			
Infusoria,	**3**	**0**	**13**
Dinobryon cases,	2	0	0
Mallomonas,	1	0	0
Vorticella,	0	0	13
Miscellaneous, Zoöglœa,	**3**	**116**	**0**
TOTAL,	46	337	280

Chemical Examination of Water from Five Mile River and Furnace Pond, in Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14013	Mar. 20	V. slight.	Cons.	.42	2.70	0.55	.0008	.0134	.0122	.0012	.16	.0050	.0001	.4519	1.3
14014	Mar. 20	Slight.	V. slight.	.38	3.85	1.45	.0034	.0170	.0150	.0020	.17	.0050	.0001	.4266	1.3
14362	May 23	Slight.	Slight.	.38	2.95	0.65	.0002	.0140	.0126	.0014	.18	.0000	.0000	.4142	0.8
14363	May 23	Slight.	Slight.	.28	2.40	0.75	.0010	.0152	.0128	.0024	.19	.0000	.0000	.6574	0.9
14435	June 6	Distinct.	Slight.	.26	3.30	1.35	.0000	.0198	.0182	.0016	.16	.0030	.0000	.3838	0.6
14484	June 18	Slight.	Slight.	.25	3.05	1.00	.0002	.0138	.0120	.0018	.15	.0030	.0000	.3182	0.6

Odor, vegetable. —— The first two samples were collected from the Five Mile River just above its entrance into Furnace Pond; the remaining samples from Furnace Pond near its outlet.

BROOKFIELD.

Microscopical Examination of Water from Five Mile River and Furnace Pond, Brookfield.

[Number of organisms per cubic centimeter.]

	1895.					
	March.	May.	March.	May.	June.	June.
Day of examination,	21	25	21	25	7	19
Number of sample,	14013	14362	14014	14363	14435	14484
PLANTS.						
Diatomaceæ,	**25**	**350**	**4**	**164**	**618**	**294**
Asterionella,	2	0	0	14	4	8
Ceratoneis,	0	1	0	0	0	0
Cyclotella,	0	1	0	80	588	268
Diatoma,	2	0	0	0	0	0
Fragilaria,	0	4	0	0	0	0
Melosira,	9	18	0	22	3	0
Navicula,	0	0	0	1	0	1
Synedra,	9	76	4	28	1	2
Tabellaria,	3	250	0	19	22	15
Cyanophyceæ, Anabæna,	**0**	**0**	**0**	**0**	**70**	**11**
Algæ,	**0**	**10**	**0**	**21**	**3**	**4**
Chlorococcus,	0	4	0	0	0	0
Desmidium,	0	1	0	0	0	0
Protococcus,	0	0	0	20	3	4
Raphidium,	0	1	0	0	0	0
Scenedesmus,	0	4	0	1	0	0
Fungi, Crenothrix,	**0**	**100**	**0**	**1**	**0**	**0**
ANIMALS.						
Infusoria,	**21**	**99**	**94**	**1**	**0**	**1**
Dinobryon cases,	0	96	88	0	0	0
Euglena,	4	0	3	0	0	0
Mallomonas,	0	0	0	0	0	1
Monas,	1	1	0	0	0	0
Peridinium,	16	2	3	0	0	0
Tintinnidium,	0	0	0	1	0	0
Vermes,	**0**	**0**	**0**	**3**	**0**	**1**
Anurea,	0	0	0	2	0	1
Polyarthra,	0	0	0	1	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**260**	**88**	**0**	**0**
TOTAL,	46	559	358	278	691	311

BROOKFIELD.

Chemical Examination of Water from Rice's Mill-pond, Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14012	Mar. 20	Slight.	Slight.	.38	3.45	1.40	.0020	.0186	.0158	.0028	.16	.0030	.0001	.4756	1.3
14384	May 29	Distinct.	Cons.	.68	3.40	1.90	.0020	.0226	.0204	.0022	.16	.0000	.0000	.6574	0.9

Odor of the first sample, vegetable; of the second, none, becoming distinctly vegetable on heating. —— The samples were collected from Rice's mill-pond, about one mile south of Brookfield village, on the stream which joins the Quaboag River near the Brookfield station of the Boston & Albany Railroad.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14012, 159; No. 14384, 228.

Water Supply of Brookline.

Chemical Examination of Water from a Faucet at the Low-service Pumping Station of the Brookline Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13735	Jan. 31	None.	None.	.00	9.90	.0006	.0032	.68	.0450	.0000	.0671	4.7	.0000
13833	Feb. 18	None.	None.	.01	9.40	.0000	.0024	.64	.0450	.0000	.0663	4.3	.0010
13990	Mar. 18	None.	None.	.03	9.10	.0000	.0018	.63	.0330	.0000	.0806	4.6	.0020
14146	Apr. 15	None.	None.	.02	8.60	.0004	.0036	.53	.0280	.0000	.1343	4.4	.0010
14301	May 14	None.	None.	.03	8.90	.0004	.0018	.56	.0400	.0000	.0790	4.3	.0020
14509	June 19	None.	None.	.03	9.40	.0000	.0028	.60	.0380	.0000	.0390	4.4	.0000
14707	July 24	None.	None.	.01	9.15	.0010	.0022	.64	.0280	.0000	.0847	4.6	.0015
14869	Aug. 19	None.	None.	.01	9.50	.0010	.0020	.60	.0400	.0000	.0780	4.7	.0100
15180	Sept. 16	None.	None.	.03	8.80	.0010	.0022	.60	.0350	.0000	.0585	4.2	.0020
15361	Oct. 11	None.	None.	.07	8.90	.0000	.0018	.60	.0400	.0000	.0718	4.6	.0020
15567	Nov. 18	None.	None.	.02	9.00	.0004	.0038	.61	.0280	.0000	.0975	4.2	.0030
15735	Dec. 16	None.	None.	.04	9.20	.0010	.0038	.56	.0330	.0000	.0885	4.4	.0020
Av.	1895	....	....	.02	9.15	.0005	.0026	.60	.0361	.0000	.0719	4.4	.0022
Av.	1894	....	....	.02	9.01	.0010	.0017	.65	.0308	.0001	.0593	4.5	.0035

Note to analyses of 1895: Odor, none. —— The samples were collected from a faucet at the low-service pumping station located near the Charles River, in the West Roxbury District of the city of Boston, and represent a mixture of water from the filter-gallery and tubular wells.

Microscopical Examination.

An insignificant number of organisms, generally *Crenothrix*, was found in these samples.

BROOKLINE.

Chemical Examination of Water from the Covered Reservoir of the Brookline Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13734	Jan. 31	None.	None.	.00	9.10	.0000	.0026	.68	.0400	.0000	.0577	4.7	.0000
13832	Feb. 18	None.	None.	.04	9.60	.0000	.0022	.63	.0430	.0000	.0702	4.6	.0000
13991	Mar. 18	None.	None.	.02	8.10	.0000	.0028	.59	.0300	.0000	.0885	4.6	.0020
14147	Apr. 16	None.	V. slight.	.01	8.50	.0002	.0020	.58	.0380	.0000	.0932	4.5	.0010
14300	May 14	None.	None.	.03	9.10	.0000	.0014	.59	.0420	.0000	.0869	4.3	.0100
14510	June 19	None.	None.	.03	9.00	.0000	.0026	.60	.0230	.0000	.0296	4.4	.0070
14708	July 24	None.	None.	.01	8.25	.0000	.0018	.63	.0280	.0000	.0770	4.7	.0050
14868	Aug. 19	None.	None.	.02	9.70	.0000	.0020	.57	.0450	.0000	.0780	4.3	.0030
15179	Sept. 16	None.	None.	.02	8.50	.0004	.0028	.58	.0330	.0000	.0686	4.2	.0020
15362	Oct. 11	None.	V. slight.	.07	8.80	.0000	.0016	.60	.0400	.0000	.0718	4.4	.0010
15568	Nov. 19	None.	None.	.03	9.30	.0002	.0032	.61	.0250	.0000	.1053	4.3	.0050
15736	Dec. 16	None.	V. slight.	.04	8.80	.0008	.0042	.57	.0280	.0000	.0693	4.3	.0020
Av.	1895	....	....	.03	8.90	.0001	.0024	.60	.0346	.0000	.0747	4.5	.0032
Av.	1894	....	....	.02	9.15	.0001	.0017	.63	.0363	.0000	.0566	4.4	.0025

NOTE to analyses of 1895: Odor, none.—— The samples were collected from the reservoir.

Microscopical Examination.

An insignificant number of organisms, generally *Crenothrix*, was found in these samples.

Chemical Examination of Water from Charles River, opposite the Filter-gallery of the Brookline Water Works at West Roxbury.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13733	Jan. 31	V. slight.	Slight.	0.75	4.55	1.95	.0004	.0192	.0184	.0008	.37	.0200	.0000	.7386	1.4
14145	Apr. 15	Slight.	Slight.	0.80	3.85	2.00	.0006	.0226	.0202	.0024	.34	.0020	.0000	.8374	1.2
14299	May 14	V. slight.	Slight.	1.40	5.10	2.85	.0016	.0288	.0274	.0014	.37	.0070	.0000	1.1202	1.6
14508	June 19	Slight.	Slight.	1.00	4.30	2.10	.0000	.0272	.0210	.0062	.34	.0070	.0002	.7059	1.6
14706	July 24	Slight.	Slight.	1.00	5.00	2.00	.0016	.0258	.0226	.0032	.49	.0030	.0000	.8162	1.6
14867	Aug 19	V. slight.	Slight.	0.45	4.80	1.90	.0002	.0210	.0192	.0018	.46	.0030	.0000	.5928	1.6
15178	Sept. 16	V. slight.	Slight.	0.40	5.00	1.60	.0000	.0174	.0166	.0008	.53	.0030	.0001	.4446	1.6
15360	Oct. 11	Distinct.	Slight.	0.38	5.20	2.05	.0002	.0252	.0212	.0040	.60	.0100	.0001	.5476	1.7
15566	Nov. 18	Slight.	Slight.	1.20	5.15	2.85	.0006	.0258	.0238	.0020	.44	.0070	.0001	1.3650	1.4
15734	Dec. 16	V. slight.	V. slight.	1.10	5.45	2.35	.0014	.0234	.0222	.0012	.56	.0600	.0001	.9394	1.4
Av.	....	....	....	0.85	4.84	2.16	.0007	.0236	.0212	.0024	.45	.0122	.0001	.8108	1.5

Odor, distinctly vegetable and frequently mouldy.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 56.

CAMBRIDGE.

Water Supply of Cambridge.

Chemical Examination of Water from Fresh Pond, Cambridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13584	Jan. 2	V. slight.	Cons.	.45	7.60	1.80	.0110	.0212	.0200	.0012	0.73	.0230	.0000	.3835	3.6
13753	Feb. 5	Slight.	Slight.	.40	7.65	1.75	.0004	.0186	.0170	.0016	0.73	.0300	.0000	.4740	3.5
13918	Mar. 5	V. slight.	V. slight.	.33	7.55	2.40	.0008	.0204	.0194	.0010	0.72	.0380	.0000	.4812	3.5
14079	Apr. 2	Distinct.	Cons.	.33	7.45	2.00	.0002	.0236	.0196	.0040	0.66	.0380	.0001	.4427	2.9
14244	May 6	Distinct.	Cons.	.40	7.15	2.55	.0034	.0230	.0184	.0046	0.70	.0230	.0003	.4466	3.5
14424	June 4	Distinct.	Cons.	.30	7.00	2.15	.0072	.0244	.0194	.0050	0.63	.0220	.0003	.4978	3.1
14587	July 9	Distinct.	Cons.	.38	6.70	2.45	.0078	.0248	.0200	.0048	0.63	.0220	.0005	.5214	3.1
14769	Aug. 6	Distinct.	Cons.	.28	6.75	1.65	.0016	.0274	.0212	.0062	0.76	.0180	.0004	.5382	3.5
14945	Sept. 3	Distinct, white.	Slight, green.	.20	7.25	1.95	.0000	.0340	.0176	.0164	0.67	.0030	.0003	.4235	3.0
15296	Oct. 2	Distinct, green.	Cons., green.	.25	7.30	1.75	.0008	.0328	.0182	.0136	0.66	.0080	.0003	.4017	2.9
15474	Nov. 5	Distinct, clayey.	Slight.	.37	8.25	2.60	.0270	.0224	.0182	.0042	0.70	.0120	.0012	.5109	3.6
15659	Dec. 3	Distinct, clayey.	Slight, yellow.	.50	8.50	2.80	.0046	.0212	.0178	.0034	0.71	.0280	.0020	.4680	3.6
Av.	....	....	....	.35	7.43	2.15	.0054	.0245	.0189	.0055	0.69	.0221	.0004	.4658	3.3

Averages by Years.

-	1887*	-	-	.04	17.32	1.94	.0105	.0180	-	-	2.11	.0266	-	-	-
-	1888	-	-	.17	11.11	1.79	.0132	.0206	-	-	1.10	.0261	.0007	-	-
-	1889	-	-	.11	9.86	1.83	.0145	.0220	.0170	.0050	0.90	.0334	.0008	-	-
-	1890	-	-	.11	8.87	1.41	.0098	.0221	.0168	.0053	0.83	.0303	.0004	-	4.1
-	1891	-	-	.15	7.94	1.80	.0095	.0235	.0162	.0073	0.75	.0333	.0004	-	3.8
-	1892	-	-	.16	7.23	1.57	.0086	.0210	.0161	.0049	0.67	.0249	.0003	-	3.4
-	1893	-	-	.27	6.66	1.82	.0106	.0202	.0165	.0037	0.58	.0285	.0006	.4043	3.2
-	1894	-	-	.30	6.98	1.81	.0063	.0199	.0162	.0037	0.66	.0183	.0007	.4059	3.1
-	1895	-	-	.35	7.43	2.15	.0054	.0245	.0189	.0055	0.69	.0221	.0004	.4658	3.3

* June to December.

Note to analyses of 1895: Odor, vegetable, frequently becoming stronger and sometimes unpleasant on heating. —— The samples were collected from the pump well at the pumping station. For monthly record of height of water in this pond, see page 135.

CAMBRIDGE.

Microscopical Examination of Water from Fresh Pond, Cambridge.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	3	6	6	3	6	7	10	8	4	3	6	3
Number of sample,	13584	13753	13918	14079	14244	14424	14587	14769	14945	15296	15474	15659
PLANTS.												
Diatomaceæ,	**834**	**423**	**69**	**72**	**1,227**	**1,321**	**130**	**146**	**15**	**16**	**580**	**532**
Asterionella,	500	256	19	20	264	0	0	8	0	0	83	284
Cyclotella,	2	7	3	5	56	236	60	52	0	6	2	0
Cymbella,	0	0	0	0	0	352	0	0	0	0	0	0
Diatoma,	0	0	0	1	0	0	0	0	5	0	0	0
Fragilaria,	20	0	0	0	7	0	0	4	0	0	0	2
Melosira,	61	0	0	30	660	0	18	32	5	0	432	50
Navicula,	0	0	0	0	1	1	0	0	0	4	0	0
Stephanodiscus,	72	22	19	8	76	0	0	0	3	0	0	196
Surirella,	0	0	0	0	0	0	0	0	0	0	52	0
Synedra,	11	10	2	3	3	8	0	41	1	6	0	0
Tabellaria,	168	128	26	5	160	724	52	9	1	0	11	0
Cyanophyceæ,	**3**	**0**	**0**	**0**	**0**	**18**	**1,828**	**295**	**312**	**146**	**2**	**0**
Anabæna,	0	0	0	0	0	0	196	0	0	2	0	0
Clathrocystis,	0	0	0	0	0	0	32	0	0	12	1	0
Microcystis,	0	0	0	0	0	0	1,600	19	152	132	1	0
Oscillaria,	3	0	0	0	0	18	0	276	160	0	0	0
Algæ,	**6**	**2**	**6**	**6**	**4**	**6**	**81**	**14**	**60**	**4**	**3**	**0**
Closterium	1	2	6	3	4	0	5	0	0	0	0	0
Glœocapsa,	0	0	0	0	0	0	52	0	0	2	0	0
Protococcus,	4	0	0	1	0	0	21	5	55	0	0	0
Raphidium,	0	0	0	2	0	0	2	3	1	2	2	0
Scenedesmus,	1	0	0	0	0	4	1	0	1	0	0	0
Staurastrum,	0	0	0	0	0	2	0	6	3	0	1	0
Fungi, Crenothrix,	**3**	**0**	**1**	**12**	**1**	**0**	**5**	**0**	**1**	**4**	**0**	**0**
ANIMALS.												
Infusoria,	**1**	**5**	**13**	**129**	**15**	**2**	**9**	**8**	**10**	**6**	**7**	**0**
Ceratium,	0	0	0	0	0	0	0	0	3	4	0	0
Ciliated infusorian,	0	0	0	124	0	0	0	0	0	0	0	0
Dinobryon cases,	0	1	0	0	0	2	0	0	0	0	1	0
Euglena,	0	0	0	0	1	0	0	0	0	0	1	0
Peridinium,	0	0	0	0	2	0	6	0	0	2	0	0
Trachelomonas,	1	4	13	5	12	0	3	8	7	0	5	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**4**	**55**	**300**	**0**	**0**
TOTAL,	847	430	89	219	1,259	1,347	2,053	467	453	476	592	532

CAMBRIDGE.

Chemical Examination of Water from Stony Brook Storage Reservoir, Waltham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13608	Jan. 7	V. slight.	Slight.	0.68	7.00	2.60	.0022	.0380	.0186	.0194	.62	.0530	.0001	.6708	3.0
13767	Feb. 5	V. slight.	V. slight.	0.75	6.95	3.35	.0010	.0250	.0232	.0018	.56	.0400	.0000	.8058	2.5
13921	Mar. 5	V. slight.	V. slight.	0.63	6.60	2.10	.0016	.0180	.0174	.0006	.55	.0430	.0001	.6376	2.3
14084	Apr. 2	V. slight.	Slight.	0.83	5.50	2.30	.0016	.0238	.0220	.0018	.39	.0300	.0001	.7469	1.7
14245	May 6	Slight.	Slight.	1.05	4.90	2.25	.0000	.0232	.0208	.0024	.52	.0180	.0000	.8431	1.9
14414	June 5	Distinct.	Slight.	1.00	5.55	2.80	.0036	.0292	.0260	.0032	.45	.0180	.0002	.8702	2.2
14592	July 9	Distinct.	Cons.	0.90	4.80	1.55	.0018	.0308	.0240	.0068	.45	.0120	.0002	.7426	2.1
14789	Aug. 7	Slight, green.	Slight.	0.60	5.20	2.40	.0018	.0256	.0216	.0040	.45	.0150	.0002	.6630	2.6
15302	Oct. 2	Distinct.	Slight.	0.55	5.80	2.30	.0010	.0324	.0310	.0014	.47	.0030	.0001	.6100	2.1
15481	Nov. 5	Distinct.	Slight.	1.15	6.85	3.15	.0020	.0350	.0298	.0052	.49	.0280	.0001	1.1505	2.2
15664	Dec. 3	Slight, clayey.	Slight, earthy.	1.15	5.70	2.75	.0000	.0272	.0238	.0034	.40	.0180	.0000	.9610	1.8
Av.	....	....	....	0.84	5.90	2.41	.0015	.0280	.0235	.0045	.49	.0253	.0001	.7910	2.2

Averages by Years.

-	1887*	-	-	0.81	6.21	1.82	.0049	.0347	-	-	.43	.0035	-	-	-
-	1888	-	-	0.78	5.15	1.93	.0031	.0285	-	-	.34	.0169	.0002	-	-
-	1889	-	-	0.87	4.59	1.47	.0032	.0280	.0249	.0031	.38	.0162	.0003	-	-
-	1890	-	-	0.61	5.86	2.02	.0016	.0222	.0182	.0040	.37	.0208	.0002	-	2.3
-	1891	-	-	0.56	4.99	1.86	.0016	.0213	.0183	.0030	.34	.0163	.0001	-	1.9
-	1892	-	-	0.72	5.43	1.79	.0015	.0241	.0202	.0039	.37	.0208	.0001	-	2.2
-	1893	-	-	0.66	5.32	1.97	.0020	.0235	.0196	.0039	.44	.0208	.0001	.5956	2.1
-	1894	-	-	0.73	5.61	2.03	.0018	.0211	.0189	.0022	.46	.0174	.0001	.6422	2.1
-	1895	-	-	0.84	5.90	2.41	.0015	.0280	.0235	.0045	.49	.0253	.0001	.7910	2.2

* June to November.

NOTE to analyses of 1895: Odor, generally faintly vegetable, very rarely none; on heating the odor generally became stronger and sometimes mouldy. —— The samples were collected from the reservoir, near the surface, at the dam. For monthly record of height of water in this reservoir, see page 135.

CAMBRIDGE.

Microscopical Examination of Water from Stony Brook Storage Reservoir, Waltham.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Oct.	Nov.	Dec.
Day of examination,	8	7	6	4	7	5	10	10	3	7	4
Number of sample,	13608	13767	13921	14084	14245	14414	14592	14789	15302	15481	15664
PLANTS.											
Diatomaceæ,	**1**	**13**	**2**	**6**	**211**	**96**	**4,792**	**817**	**200**	**18**	**54**
Asterionella,	0	0	0	0	0	1	396	700	24	9	1
Cyclotella,	0	0	0	0	0	9	1,020	44	0	0	0
Diatoma,	0	0	0	1	0	0	0	0	0	4	2
Fragilaria,	0	0	0	0	0	5	0	0	0	0	10
Synedra,	1	13	2	2	200	2	56	34	0	2	15
Tabellaria,	0	0	0	3	11	79	3,320	39	176	3	26
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**0**	**139**	**6**	**14**	**0**	**0**
Anabæna,	0	0	0	0	0	0	136	0	3	0	0
Clathrocystis,	0	0	0	0	0	0	3	0	3	0	0
Cœlosphærium,	0	0	0	0	0	0	0	0	8	0	0
Merismopedia,	0	0	0	0	0	0	0	6	0	0	0
Algæ,	**1**	**0**	**0**	**0**	**9**	**22**	**29**	**5**	**1**	**0**	**0**
Protococcus,	0	0	0	0	0	22	28	0	0	0	0
Raphidium,	0	0	0	0	0	0	1	5	1	0	0
Zoöspores,	1	0	0	0	9	0	0	0	0	0	0
Fungi, Crenothrix,	**0**	**3**	**1**	**5**	**19**	**0**	**0**	**0**	**1**	**124**	**4**
ANIMALS.											
Infusoria,	**8**	**0**	**0**	**10**	**16**	**558**	**1**	**8**	**4**	**5**	**0**
Dinobryon,	0	0	0	8	0	292	0	0	0	0	0
Dinobryon cases,	0	0	0	0	16	258	0	7	0	0	0
Mallomonas,	0	0	0	0	0	8	0	0	0	1	0
Peridinium,	8	0	0	2	0	0	1	1	0	1	0
Trachelomonas,	0	0	0	0	0	0	0	0	4	3	0
Vermes,	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**	**2**	**0**	**0**
Anurea,	0	0	0	0	0	0	1	0	2	0	0
Rotifer,	0	0	0	0	2	2	0	0	0	0	0
Crustacea, Daphnia,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.12**	**0**	**0**
Miscellaneous, Zoöglœa,	**0**	**0**	**11**	**0**	**84**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL,	10	16	14	21	341	678	4,962	836	222	147	58

CAMBRIDGE.

Chemical Examination of Water from Hobbs Brook, at Winter Street, Waltham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Suspended		Nitrates.	Nitrites.		
	1895.														
13692	Jan. 19	V. slight.	V. slight.	1.10	8.10	2.90	.0016	.0266	.0252	.0014	.52	.0330	.0001	.9756	3.1
13816	Feb. 13	V. slight.	Slight.	0.75	6.55	2.00	.0056	.0194	.0184	.0010	.51	.0400	.0000	.6720	2.5
13975	Mar. 13	V. slight.	Cons.	0.85	5.75	2.55	.0002	.0318	.0280	.0038	.40	.0350	.0002	.9040	2.1
14128	Apr. 10	Slight.	Slight.	1.10	5.80	2.60	.0004	.0338	.0296	.0042	.40	.0180	.0001	1.0125	1.9
14238	May 3	Slight.	Slight, brown.	1.35	6.20	2.85	.0002	.0296	.0284	.0012	.44	.0150	.0000	1.2474	2.3
14446	June 10	Slight.	Cons.	1.20	5.95	2.60	.0044	.0270	.0242	.0028	.40	.0120	.0002	.9576	2.2
14594	July 9	Distinct.	Cons., rusty.	1.30	5.60	2.10	.0032	.0354	.0324	.0030	.42	.0150	.0002	1.1060	2.7
14837	Aug. 13	Decided.	Cons., brown.	1.00	8.00	2.90	.0036	.0412	.0344	.0068	.54	.0130	.0004	1.2480	3.4
15311	Oct. 4	V. slight	V. slight.	0.18	6.75	1.75	.0008	.0116	.0104	.0012	.68	.0330	.0002	.2535	2.9
15495	Nov. 6	Slight.	Slight, dark.	1.25	8.25	4.20	.0000	.0392	.0364	.0028	.49	.0180	.0001	1.6380	2.6
15681	Dec. 3	V. slight.	V. slight.	1.10	5.95	2.90	.0002	.0236	.0202	.0034	.42	.0390	.0001	.9633	2.1
Av.	1895	....	....	1.02	6.63	2.67	.0018	.0290	.0261	.0029	.47	.0246	.0001	.9071	2.5
Av.	1894*	....	....	0.65	6.68	1.93	.0007	.0214	.0197	.0017	.53	.0194	.0001	.5862	2.5

* June to December.

NOTE to analyses of 1895: Odor, distinctly vegetable and sometimes mouldy, becoming stronger on heating.——The samples were collected from the brook. The quality of the water of this source and of the Stony Brook reservoir may have been affected during much of the year by work incident to the construction of a storage reservoir upon Hobbs Brook above the point where these samples were collected.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 155.

CAMBRIDGE.

Table Showing Heights of Water in Fresh Pond and in Stony Brook Storage Reservoir on the First Day of Each Month in 1895.

[Heights are in feet above Cambridge city base.]

FRESH POND. HIGH WATER, 16.85. Date.	Height of Water.	STONY BROOK RESERVOIR. ROLLWAY, 81.00. Date.	Height of Water.
1895.		1895.	
Jan. 1,	13.90	Jan. 1,	80.33
Feb. 1,	15.35	Feb. 1,	81.16
Mar. 1,	15.68	Mar. 1,	80.99
April 1,	16.67	April 1,	81.55
May 1,	16.68	May 1,	81.41
June 1,	17.29	June 1,	80.88
July 1,	16.63	July 1,	79.75
Aug. 1,	14.74	Aug. 1,	81.23
Sept. 1,	12.63	Sept. 1,	81.05
Oct. 1,	11.59	Oct. 1,	77.33
Nov. 1,	12.98	Nov 1,	81.50
Dec. 1,	13.49	Dec. 1,	81.77

Water Supply of Chelsea.

(See *Boston, Mystic Works.*)

Water Supply of Cheshire. — Cheshire Water Company.

Chemical Examination of Water from the Reservoir of the Cheshire Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
15230	Sept. 21	Slight.	Slight.	.03	9.25	-	.0016	.0046	.0024	.0022	.11	.0280	.0000	.0858	6.6

Odor, faintly unpleasant, becoming distinctly vegetable on heating.—The sample was collected from the reservoir at a time when the water was unusually low.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

CHESTER.

Water Supply of Chester.

Chemical Examination of Water from the Austin Brook Reservoir of the Chester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14261	May 8	V. slight.	V. slight.	.15	2.45	1.00	.0008	.0066	.0052	.0014	.08	.0030	.0000	.1655	0.9
15280	Oct. 1	Slight.	Slight.	.15	3.65	0.80	.0014	.0188	.0170	.0018	.13	.0050	.0000	.3003	1.7

Odor of the first sample, none; of the second, very faintly vegetable. —— The samples were collected from the reservoir.

Microscopical Examination.

No. 14261, Diatomaceæ, *Meridion*, 9; *Navicula*, 1; *Synedra*, 56. Fungi, *Cladothrix*, 2; *Crenothrix*, 5. Miscellaneous, *Zoöglœa*, 20. Total, 93.

No. 15280, Fungi, *Crenothrix*, 1; *Molds*, 2. Total, 3.

Water Supply of Chicopee.

Chemical Examination of Water from Cooley Brook and the Cooley Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13730	Jan. 29	V. slight.	V. slight.	.30	3.80	0.95	.0016	.0066	.0046	.0020	.11	.0080	.0000	.2670	1.1
14042	Mar. 25	V. slight.	Slight.	.05	3.05	0.60	.0000	.0036	.0026	.0010	.11	.0070	.0000	.0616	0.9
14393	May 30	Slight.	Cons.	.60	3.70	0.90	.0042	.0132	.0090	.0042	.15	.0050	.0001	.0522	1.3
14755	July 31	V. slight.	Cons., brown.	.08	3.60	0.75	.0000	.0070	.0032	.0038	.11	.0100	.0000	.1248	1.1
15305	Oct. 1	Slight.	Slight.	.23	4.00	1.10	.0022	.0040	.0032	.0008	.16	.0030	.0000	.1895	0.9
15732	Dec. 16	V. slight.	Slight.	.30	4.00	1.25	.0008	.0082	.0046	.0036	.09	.0070	.0000	.2579	0.6
Av.	1895	....	....	.26	3.69	0.92	.0015	.0071	.0045	.0026	.12	.0067	.0000	.2255	1.0
Av.	1894	....	....	.58	4.16	1.08	.0014	.0091	.0072	.0019	.10	.0042	.0000	.4358	1.1

NOTE to analyses of 1895: Odor, vegetable or none; in May, vegetable and unpleasant. —— No. 14042 was collected from a brook flowing into Cooley Brook reservoir from the northwest; the others from Cooley Brook Reservoir.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 67. The highest number was found in May, and consisted chiefly of *Zoöglœa*.

CHICOPEE.

Chemical Examination of Water from Morton Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended.					
	1895.														
13731	Jan. 29	V. slight.	V. slight.	.05	3.75	0.45	.0010	.0096	.0078	.0018	.13	.0100	.0000	.0513	1.1
14041	Mar. 25	Slight.	Slight, green.	.03	3.90	0.65	.0000	.0066	.0048	.0018	.15	.0070	.0000	.0539	0.9
14392	May 30	V. slight.	Cons.	.05	3.45	0.40	.0006	.0046	.0032	.0014	.13	.0090	.0000	.0912	1.1
14756	July 31	V. slight.	Slight, brown.	.04	3.80	0.25	.0000	.0018	.0010	.0008	.11	.0050	.0000	.0936	0.9
15304	Oct. 1	V. slight.	Slight.	.05	3.75	0.60	.0030	.0040	.0020	.0020	.14	.0070	.0000	.0468	0.6
15733	Dec. 16	V. slight.	Cons.	.07	3.90	0.70	.0028	.0300	.0284	.0016	.10	.0100	.0000	.0939	0.6
Av.	1895	....	....	.05	3.76	0.51	.0012	.0095	.0079	.0016	.13	.0080	.0000	.0718	0.9
Av.	1894	....	....	.03	3.76	0.59	.0005	.0030	.0023	.0007	.12	.0103	.0000	.0594	1.1

NOTE to analyses of 1895: Odor, vegetable or none. —— The samples were collected from the reservoir.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 15.

Chemical Examination of Water from Dingle Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended.					
	1895.														
13701	Jan. 22	V. slight	Slight, white.	.10	3.90	0.80	.0032	.0056	.0046	.0010	.22	.0120	.0000	.1201	1.3
14395	May 30	Distinct.	Cons., brown.	.23	3.60	0.90	.0010	.0170	.0052	.0118	.27	.0150	.0001	.2181	1.1
15258	Sept. 25	Decided, white.	Slight.	.38	4.60	1.55	.0018	.0428	.0200	.0228	.30	.0020	.0001	.2902	1.4
Av.	....	....	....	.24	4.03	1.08	.0020	.0218	.0099	.0119	.26	.0097	.0001	.2095	1.3

Odor, vegetable. —— The first two samples were collected from faucets in Chicopee supplied from Dingle Brook, and the last sample from the storage reservoir on Dingle Brook.

Microscopical Examination.

The number of organisms per cubic centimeter found in these samples was as follows: No. 13701 56; No. 14395, 506; No. 15258, 240.

CHICOPEE.

Chemical Examination of Water from the Powderhorn Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13702	Jan. 22	None.	V. slight.	.08	2.80	0.55	.0000	.0030	.0022	.0008	.12	.0000	.0000	.0948	0.8
14394	May 30	V. slight.	Slight.	.15	2.30	0.75	.0006	.0046	.0030	.0016	.14	.0050	.0000	.1254	0.8
15259	Sept. 25	Slight.	Slight.	.18	3.25	0.75	.0004	.0072	.0052	.0020	.13	.0070	.0001	.1053	0.8
Av.	....	....	....	.14	2.78	0.68	.0003	.0049	.0035	.0014	.13	.0040	.0000	.1085	0.8

Odor of the first two samples, none; of the last, faintly vegetable. —— The first and last samples were collected from faucets in the village of Willimansett, which is supplied from this reservoir, and the second sample from the reservoir.

Microscopical Examination of Water from the Powderhorn Brook Reservoir, Chicopee.

[Number of organisms per cubic centimeter.]

	1895. January.	1895. June.	1895. September.
Day of examination,	23	1	27
Number of sample,	13702	14394	15259
PLANTS.			
Diatomaceæ,	0	3	160
Melosira,	0	0	140
Synedra,	0	3	16
Tabellaria,	0	0	4
Cyanophyceæ, Anabæna,	0	0	24,000
Algæ,	0	0	6
Pediastrum,	0	0	2
Staurastrum,	0	0	4
Fungi, Crenothrix,	pr.	30	0
ANIMALS.			
Infusoria,	0	3	2
Dinobryon cases,	0	2	0
Peridinium,	0	1	2
Vermes,	0	0	10
Anurea,	0	0	6
Rotifer,	0	0	4
Miscellaneous, Zoöglœa,	0	324	0
TOTAL,	pr.	360	24,178

Water Supply of Clinton.

Chemical Examination of Water from the Sources of Supply of the Clinton Water Works, Sterling.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14850	Aug.16	Decided.	Cons.	.95	5.15	2.70	.0186	.0512	.0476	.0036	.48	.0000	.0001	1.0842	1.3
15802	Dec. 24	Slight.	Slight.	.93	3.80	1.75	.0046	.0218	.0200	.0018	.14	.0050	.0001	.8547	0.8
14851	Aug.16	Decided.	Slight.	.28	3.90	1.85	.0092	.0370	.0354	.0016	.24	.0000	.0000	.6396	0.5
15803	Dec. 24	Slight.	Slight.	.50	2.80	1.25	.0000	.0136	.0114	.0022	.16	.0000	.0000	.5529	0.5
15804	Dec. 24	Slight.	Slight.	.28	3.00	0.85	.0002	.0112	.0098	.0014	.16	.0120	.0001	.3480	0.9
14852	Aug.16	Slight.	Slight.	.15	3.30	0.95	.0062	.0156	.0142	.0014	.26	.0000	.0000	.2730	0.9
15805	Dec. 24	Slight.	Slight.	.25	2.70	1.30	.0010	.0110	.0090	.0020	.15	.0070	.0000	.3434	0.5
15806	Dec. 24	Slight.	Slight.	.20	2.75	1.25	.0022	.0204	.0166	.0038	.17	.0070	.0000	.3349	0.3

Odor of Nos. 14850 and 15802, distinctly vegetable; of No. 14851, distinctly vegetable and unpleasant; of No. 15803, decidedly vegetable and mouldy; of Nos. 15804 and 14852, faintly vegetable; of the last two samples, none. —— The samples were collected as follows: No. 14850, from Fitch's Pond near the shore; No. 15802, from Fitch's Pond at the deepest part; No. 14851, from Heywood's Pond near the shore; No. 15803, from Heywood's Pond 50 feet above the dam; No. 15804, from Spring Basin, near the gate-house; Nos. 14852, 15805 and 15806, from Lyndes Pond.

Microscopical Examination of Water from the Sources of Supply of the Clinton Water Works, Sterling.

[Number of organisms per cubic centimeter.]

	1895.							
	Aug.	Dec.	Aug.	Dec.	Dec.	Aug.	Dec.	Dec.
Day of examination,	19	27	19	27	27	19	27	27
Number of sample,	14850	15802	14851	15803	15804	14852	15805	15806
PLANTS.								
Diatomaceæ,	**228**	**3**	**238**	**68**	**53**	**36**	**47**	**40**
Asterionella,	10	2	140	7	12	6	7	0
Cyclotella,	72	0	44	0	0	8	0	0
Cymbella,	0	0	0	0	1	0	0	0
Diatoma,	0	0	0	0	2	3	0	0
Melosira,	0	0	2	0	0	0	0	0
Navicula,	0	0	0	0	3	3	0	0
Synedra,	144	1	52	60	34	16	40	40
Tabellaria,	2	0	0	1	1	0	0	0

CLINTON.

Microscopical Examination of Water from the Clinton Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1895.							
	Aug.	Dec.	Aug.	Dec.	Dec.	Aug.	Dec.	Dec.
PLANTS — Con.								
Cyanophyceæ,	**542**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Aphanocapsa,	2	0	0	0	0	0	0	0
Merismopedia,	540	0	0	0	0	0	0	0
Oscillaria,	0	1	0	0	0	0	0	0
Algæ,	**422**	**0**	**60**	**1**	**1**	**7**	**1**	**0**
Arthrodesmus,	0	0	9	0	0	0	0	0
Chlorococcus,	1	0	1	0	0	0	0	0
Cosmarium,	1	0	1	0	0	2	0	0
Desmidium,	7	0	0	0	0	0	0	0
Eudorina,	2	0	0	0	0	0	0	0
Glœocapsa,	52	0	1	0	0	0	0	0
Pandorina,	0	0	0	1	0	0	0	0
Protococcus,	328	0	25	0	0	0	0	0
Raphidium,	2	0	3	0	0	0	0	0
Scenedesmus,	25	0	16	0	1	1	1	0
Spirogyra,	2	0	0	0	0	0	0	0
Staurastrum,	2	0	2	0	0	4	0	0
Staurogenia,	0	0	2	0	0	0	0	0
Fungi, Crenothrix,	**76**	**1**	**0**	**1**	**2**	**0**	**0**	**0**
ANIMALS.								
Rhizopoda, Actinophrys,	**1**	**0**	**0**	**0**	**0**	**0**	**0**	
Infusoria,	**37**	**26**	**69**	**68**	**4**	**79**	**5**	
Dinobryon,	0	19	0	68	1	0	0	
Dinobryon cases,	1	0	56	0	0	76	0	
Monas,	2	0	0	0	0	2	0	
Peridinium,	28	7	13	0	3	0	5	
Trachelomonas,	5	0	0	0	0	0	0	
Uroglena,	0	0	0	0	0	0	0	1
Vorticella,	1	0	0	0	0	1	0	0
Vermes,	**18**	**0**	**4**	**0**	**1**	**5**	**2**	
Anurea,	7	0	1	0	0	0	0	0
Polyarthra,	8	0	0	0	1	3	0	0
Rotatorian ova,	3	0	3	0	0	2	0	0
Rotifer,	0	0	0	0	0	0	2	0
Miscellaneous,	**128**	**0**	**84**	**0**	**0**	**0**	**.02**	**0**
Acarina,	.02	0	0	0	0	0	.02	0
Zoöglœa,	128	0	84	0	0	0	0	0
TOTAL,	1,452	31	455	138	61	127	55	42

WATER SUPPLY OF COHASSET. — COHASSET WATER COMPANY.

The advice of the State Board of Health to the Cohasset Water Company relative to increasing its water supply may be found on page 17 of this volume. Analyses of water from present sources of supply and of samples collected during the investigations for an additional water supply are given on succeeding pages.

COHASSET.

Chemical Examination of Water from the Tubular Wells of the Cohasset Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13609	Jan. 7	Distinct, milky.	V. slight.	.12	18.70	.0006	.0026	2.22	.0210	.0002	.0273	9.4	.0480
13782	Feb. 7	Distinct, white.	V. slight.	.18	18.30	.0000	.0032	1.90	.0180	.0000	.0245	9.0	.0500
13948	Mar. 6	Decided, milky.	None.	.28	20.40	.0002	.0006	1.83	.0150	.0000	.0277	10.3	.0980
14140	Apr. 15	Distinct.	Slight.	.10	16.80	.0000	.0016	1.84	.0150	.0000	.0553	8.7	.0700
14266	May 8	Distinct, milky.	None.	.20	17.70	.0004	.0012	1.91	.0130	.0000	.0077	7.7	.0760
14422	June 5	Distinct, milky.	Slight.	.25	16.70	.0002	.0018	1.89	.0050	.0000	.0190	8.0	.0720
14593	July 9	Decided, milky.	Slight.	.30	14.30	.0000	.0018	1.70	.0220	.0000	.0474	7.7	.0370
14785	Aug. 7	Distinct, milky.	Slight, rusty.	.20	17.10	.0000	.0004	1.88	.0210	.0000	.0000	8.0	.0900
14978	Sept. 4	Distinct, milky	Slight, rusty.	.28	18.00	.0004	.0008	1.78	.0300	.0001	.0154	7.4	.0780
15315	Oct. 7	Distinct, milky.	V. slight.	.05	14.40	.0000	.0008	1.79	.0330	.0000	.0125	7.6	.0550
15500	Nov. 7	Distinct, milky.	Slight, rusty.	.15	16.40	.0008	.0010	1.82	.0400	.0000	.0351	7.1	.1150
15671	Dec. 3	Slight, milky.	None.	.17	17.90	.0000	.0020	2.09	.0200	.0000	.0406	9.3	.0380
Av.	....	....	....	.19	17.22	.0002	.0015	1.89	.0211	.0000	.0260	8.3	.0689

Averages by Years.

-	1887*	-	-	.00	15.21	.0005	.0016	1.69	.0196	-	-	-	-
-	1888	-	-	.01	15.20	.0001	.0021	1.50	.0311	.0003	-	-	-
-	1889†	-	-	.00	11.64	.0001	.0022	1.46	.0230	.0002	-	-	-
-	1890‡	-	-	.00	-	.0000	.0048	1.48	.0150	.0003	-	-	-
-	1893	-	-	.16	17.14	.0001	.0007	1.64	.0263	.0001	.0415	8.6	.0451
-	1894	-	-	.17	17.94	.0004	.0016	1.77	.0204	.0000	.0276	8.4	.0743
-	1895	-	-	.19	17.22	.0002	.0015	1.89	.0211	.0000	.0260	8.3	.0689

* June to December. † January to May. ‡ February.

NOTE to analyses of 1895: Odor of the second sample, earthy; of the others, none. —— The samples were collected from a faucet at the pumping station while pumping.

Microscopical Examination.

The averge number of organisms per cubic centimeter found in these samples was 313, consisting almost wholly of *Crenothrix*, the highest number (1,320) being found in the February sample.

COHASSET.

Chemical Examination of Water from Green River in Cohasset and Bound Brook in Scituate.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14278	May 13	V. slight.	V. slight.	3.20	8.95	4.50	.0000	.0434	.0414	.0020	1.26	.0000	.0000	3.0020	1.1
14317	May 17	None.	V. slight	1.30	6.95	3.75	.0000	.0280	.0266	.0014	1.30	.0000	.0000	2.1725	0.8
14598	July 10	Slight.	Slight.	0.73	8.00	3.30	.0000	.0280	.0266	.0014	1.47	.0050	.0000	0.9401	1.3
14538	June 25	V. slight.	Slight, rusty.	2.10	7.45	3.90	.0008	.0470	.0452	.0018	1.10	.0050	.0000	2.1406	1.1

Odor of the first three samples, vegetable; of the last, none. —— The first three samples were collected from Green River, a small stream in the northerly part of Cohasset, about 500 feet above the point where it is crossed by the Jerusalem Road. The last sample was collected from Bound Brook, about 150 feet above the railroad bridge in the village of North Scituate.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

Chemical Examination of Water from Lily Pond, Cohasset.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13930	Mar. 5	None.	V. slight.	1.35	6.40	2.95	.0004	.0252	.0214	.0038	1.12	.0030	.0000	1.7094	1.1
14599	July 10	Decided.	Cons., brown.	2.70	6.80	4.10	.0002	.0464	.0374	.0090	0.96	.0030	.0000	2.0540	0.9

Odor, none. —— The first sample was collected at the outlet of the pond and the second at the centre.

Microscopical Examination.

No. 13930. Fungi, *Crenothrix*, 1.

No. 14599. Diatomaceæ, *Cymbella*, 2; *Melosira*, 14; *Pinnularia*, 4; *Synedra*, 5; *Tabellaria*, 3. Cyanophyceæ, *Microcystis*, 14; *Oscillaria*, 1. Algæ, *Arthrodesmus*, 2; *Cosmarium*, 3; *Glœocapsa*, 5; *Protococcus*, 81; *Raphidium*, 23. Fungi, *Crenothrix*, 1. Infusoria, *Peridinium*, 4. Vermes, *Anurea*, 4. Total, 166.

COHASSET.

Chemical Examination of Water from a Tubular Test Well in Cohasset.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14382	1895. May 28	Decided.	Heavy, sandy.	.10	18.10	.0000	.0010	3.00	.2200	.0006	.0304	5.9	.0040

Odor, none.—— The sample was collected from a tubular test well located about 1,000 feet southeast of the pumping station of the Cohasset Water Company and about 500 feet south of the railroad.

Microscopical Examination.

No organisms.

Water Supply of Concord and Lincoln.

Chemical Examination of Water from Sandy Pond, Lincoln.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13824	Feb. 15	V. slight.	V. slight.	.04	2.60	0.80	.0002	.0134	.0122	.0012	.32	.0000	.0000	.1400	0.9
13963	Mar. 11	V. slight.	V. slight.	.02	2.50	0.55	.0084	.0098	.0084	.0014	.29	.0060	.0000	.1386	0.8
14102	Apr. 8	V. slight.	Slight.	.05	3.30	1.00	.0020	.0120	.0084	.0036	.28	.0080	.0000	.1786	1.7
14855	Aug. 19	Slight.	Slight.	.02	2.15	0.55	.0008	.0174	.0154	.0020	.27	.0000	.0000	.1950	0.6
Av.	....	....	....	.03	2.64	0.72	.0028	.0131	.0111	.0020	.29	.0035	.0000	.1630	1.0

Odor, vegetable or none, occasionally unpleasant.—— The first two samples were collected from faucets in Concord supplied from the pond, and the last two from the pond.

CONCORD AND LINCOLN.

Microscopical Examination of Water from Sandy Pond, Lincoln.

[Number of organisms per cubic centimeter.]

	1895.			
	February.	March.	April.	August.
Day of examination,	16	14	9	20
Number of sample,	13824	13963	14102	14855
PLANTS.				
Diatomaceæ,	0	0	2	20
Cyclotella,	0	0	0	5
Melosira,	0	0	0	2
Synedra,	0	0	2	11
Tabellaria,	0	0	0	2
Cyanophyceæ, Merismopedia,	0	0	0	10
Algæ,	0	0	0	24
Pediastrum,	0	0	0	6
Protococcus,	0	0	0	11
Raphidium,	0	0	0	3
Scenedesmus,	0	0	0	2
Zoöspores,	0	0	0	2
Fungi, Crenothrix,	0	2	2	0
ANIMALS.				
Infusoria,	152	57	38	15
Dinobryon,	76	1	30	0
Dinobryon cases,	76	56	8	0
Monas,	0	0	0	1
Peridinium,	0	0	pr.	14
Miscellaneous, Zoöglœa,	0	0	0	34
TOTAL,	152	59	42	103

WATER SUPPLY OF COTTAGE CITY. — COTTAGE CITY WATER COMPANY.

Chemical Examination of Water from the Springs of the Cottage City Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14610	1895. July 7	None.	Slight.	.02	4.05	.0002	.0008	.91	.0080	.0000	.0237	0.5	.0040

Odor, none. —— The sample was collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

WATER SUPPLY OF DALTON FIRE DISTRICT, DALTON.

Chemical Examination of Water from the Upper Reservoir on Egypt Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
14794	1895. Aug. 8	Distinct.	Cons., rusty.	1.70	5.60	2.55	.0576	.0370	.0336	.0034	.08	.0020	.0000	1.2012	2.3

Odor, distinctly vegetable and unpleasant. Iron, .2800 parts per 100,000. —— The sample was collected from the outlet pipe from the bottom of the reservoir.

Microscopical Examination

Fungi, *Crenothrix*, 128.

DEDHAM.

Water Supply of Dedham. — Dedham Water Company.

Chemical Examination of Water from the Well of the Dedham Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13831	Feb. 18	None.	None.	.01	9.60	.0040	.0016	.93	.2250	.0000	.0585	4.2	.0000
14187	April 19	None.	None.	.02	9.10	.0000	.0012	.78	.1400	.0000	.0774	3.8	.0000
14515	June 20	None.	None.	.03	9.50	.0000	.0012	.82	.1650	.0000	.0423	3.6	.0000
14880	Aug. 21	None.	None.	.02	11.50	.0000	.0012	.88	.2100	.0000	.0156	3.8	.0000
15764	Dec. 18	None.	None.	.00	9.90	.0004	.0024	.82	.1440	.0000	.0216	3.9	.0000
Av.	....	....	....	.02	9.92	.0009	.0015	.85	.1768	.0000	.0431	3.9	.0000

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia Free.	Ammonia Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1887*	-	-	.00	10.97	.0002	.0012	.97	.2690	-	-	-	-
-	1888†	-	-	.00	10.38	.0002	.0011	.93	.2810	.0000	-	-	-
-	1889‡	-	-	.00	9.15	.0000	.0020	.93	.1700	.0000	-	-	-
-	1892	-	-	.01	10.80	.0002	.0054	.93	.2962	.0001	-	4.4	.0108
-	1893	-	-	.01	10.49	.0014	.0073	.91	.2375	.0001	.1209	4.3	.0139
-	1894	-	-	.01	10.18	.0000	.0017	.86	.2008	.0000	.0293	4.0	.0013
-	1895	-	-	.02	9.92	.0009	.0015	.85	.1768	.0000	.0431	3.9	.0000

* June to December. † January to May. ‡ April.

Note to analyses of 1895: Odor, none. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

Dighton and Somerset.

The advice of the State Board of Health to James H. Flint and others (petitioners for incorporation as the Dighton and Somerset Water Company, relative to taking the waters of Muddy Brook and Segreganset River and their tributaries in the town of Dighton, and water from any wells in these towns) may be found on pages 18–20 of this volume. Analyses of samples from various sources investigated are given below.

DIGHTON AND SOMERSET.

Chemical Examination of Water from Muddy Cove Brook, Dighton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
13828	1895. Feb. 14	V. slight.	V. slight.	1.20	5.20	1.95	.0002	.0206	.0168	.0038	.57	.0000	.0000	1.1120	0.8

Odor, distinctly vegetable. —— The sample was collected from an ice-pond on Muddy Cove Brook, about half a mile west of the village of Dighton.

Microscopical Examination.

Diatomaceæ, *Tabellaria*, 3. Infusoria, *Dinobryon cases*, 1. Total, 4.

Chemical Examination of Water from the Segreganset River and its Tributaries, Dighton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
13829	1895. Feb. 14	V. slight	Slight.	0.68	4.25	1.25	.0002	.0168	.0146	.0022	.51	.0100	.0000	0.6760	1.1
13830	Feb. 14	V. slight	Cons., earthy.	0.65	4.70	1.45	.0002	.0140	.0108	.0032	.56	.0180	.0000	0.6040	1.4
14203	Apr. 23	V. slight	V. slight.	1.00	3.95	2.00	.0002	.0200	.0186	.0014	.44	.0000	.0000	1.5010	0.8
14204	Apr. 23	V. slight.	Slight.	1.35	5.00	2.65	.0006	.0198	.0188	.0010	.57	.0100	.0000	1.6432	1.1
13827	Feb. 14	None.	V. slight.	0.00	4.30	-	.0000	.0006	-	-	.60	.0780	.0000	0.0096	0.8

Odor of the first two samples, very faintly vegetable; of the third and fourth, distinctly vegetable; of the last, none. —— The samples were collected as follows: No. 13829 from Sunken Brook at a road crossing about half a mile above its junction with the Segreganset River; No. 13830 from the Segreganset River about two miles east of the village of North Dighton; No. 14203 from the Segreganset River about three-fourths of a mile from its mouth and just above its confluence with Pine Swamp Brook; No. 14204 from Pine Swamp Brook near its confluence with the Segreganset River; No. 13827 from a spring near Pine Swamp Brook about half a mile north of the village of Dighton.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 13829, 13; No. 13830, 6; No. 14203, 64; No. 14204, 53; No. 13827, 0.

DIGHTON AND SOMERSET.

Chemical Examination of Water from Wells, Dighton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14205	Apr. 23	None.	None.	.00	11.30	.0032	.0014	0.95	.0780	.0014	.0513	3.2	.0000
14239	May 3	None.	Cons., sandy.	.00	13.50	.0000	.0042	2.09	.2500	.0000	.0346	5.3	.0080

Odor, none. —— The first sample was collected from a tubular well in the valley of the Segreganset River about half a mile from its confluence with the Taunton River; the last from a well in the valley of the Segreganset River a short distance below Pine Swamp Brook.

Microscopical Examination.

No. 14205. Diatomaceæ, *Synedra*, 1.
No. 14239. No organisms.

Water Supply of Easthampton.

Chemical Examination of Water from Bassett Brook, Easthampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13597	Jan. 3	None.	V. slight.	.03	5.15	-	.0000	.0010	-	-	.14	.0030	.0000	.4273	2.9
14255	May 7	V. slight.	Cons.	.40	3.40	1.20	.0004	.0106	.0090	.0016	.11	.0050	.0000	.3503	1.4
14962	Sept. 3	None.	V. slight.	.20	4.35	1.00	.0000	.0074	.0062	.0012	.14	.0080	.0001	.2579	1.3
Av.	....	....	....	.21	4.30	-	.0001	.0063	-	-	.13	.0053	.0000	.3452	1.9

Odor, vegetable. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

The number of organisms per cubic centimeter found in each of these samples was as follows: No. 13597, 0; No. 14255, 199; No. 14962, 3.

Water Supply of North Easton Village District, Easton.

Chemical Examination of Water from the Well of the North Easton Village District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14936	1895. Aug. 28	None.	None.	.00	3.50	.0000	.0016	.54	.0170	.0000	.0000	1.3	.0040

Odor, none. —— The sample was collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

Edgartown.

The advice of the State Board of Health to Joseph K. Nye, relative to taking the water of certain springs in Edgartown for a public water supply for that town, may be found on page 20 of this volume. Analyses of samples from Lily Pond and from tubular test wells in Edgartown are given in the following tables.

Chemical Examination of Water from Lily Pond, Edgartown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
14033	1895. Mar. 23	Distinct.	Cons.	.40	4.95	1.35	.0000	.0116	.0058	.0058	1.26	.0030	.0000	.3871	0.6

Odor, none; becoming faintly vegetable on heating. —— The sample was collected from the outlet of Lily Pond which is situated northwest of the village.

Microscopical Examination.

Total number of organisms per cubic centimeter, 159.

EDGARTOWN.

Chemical Examination of Water from Tubular Test Wells, Edgartown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14369	May 27	None.	None.	.03	7.80	.0030	.0010	1.32	.1050	.0005	.0380	2.6	.0220
15403	Oct. 19	Slight.	Slight.	.15	15.00	.0078	.0234	4.40	.1100	.0015	.3666	2.7	.0070
15626	Nov. 26	V. slight.	V. slight.	.02	3.10	.0000	.0010	0.91	.0050	.0000	.0234	0.2	.0020

Odor of the first sample, none; of the second, distinct, becoming decidedly mouldy and unpleasant on heating; of the last, distinctly earthy, becoming less strong on heating.——The first and second samples were collected from a tubular well about two miles south of the village; the last sample from a tubular well at Wintucket Bottom, about two miles from the village.

Microscopical Examination.

No. 14369. No organisms.
No 15403. Fungi, *Molds*, 1. Miscellaneous, *Zoöglœa*, 42. Total, 43.
No. 15626. No organisms.

Essex.

Chemical Examination of Water from Chebacco Lake in Essex and Hamilton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13785	Feb. 6	Distinct, green.	Slight.	.75	5.25	2.10	.0004	.0224	.0176	.0048	1.11	.0050	.0000	.7032	1.1

Odor, very faintly vegetable, becoming stronger on heating.——The sample was collected from the lake near the northerly end.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 16. Algæ, *Closterium*, 2. Infusoria, *Dinobryon*, 2; *Dinobryon cases*, 78; *Mallomonas*, 2; *Peridinium*, 14; *Synura*, 1. Total, 115.

Water Supply of Everett.

(See *Boston, Mystic Works.*)

Water Supply of Fairhaven. — Fairhaven Water Company.

Chemical Examination of Water from the Tubular Wells of the Fairhaven Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13693	Jan. 17	None.	None.	.00	5.50	.0002	.0020	1.05	.1000	.0001	.0158	1.9	.0050
13878	Feb. 23	None.	None.	.02	4.80	.0000	.0016	1.00	.0730	.0000	.0829	1.7	.0000
14200	Apr. 22	V. slight.	None.	.02	5.10	.0000	.0008	1.01	.0900	.0002	.0829	1.8	.0080
14527	June 21	None.	None.	.15	6.15	.0000	.0038	1.02	.0480	.0000	.1732	1.4	-
14939	Aug. 30	None.	V. slight	.25	5.40	.0002	.0056	1.05	.0330	.0002	.3850	1.6	.0200
15453	Oct. 31	None.	V. slight.	.38	6.20	.0000	.0090	1.04	.0320	.0000	.4953	1.8	-
15781	Dec. 20	None.	None.	.12	5.50	.0006	.0068	0.98	.0350	.0000	.1848	1.8	.0050
Av.	....	....	....	.13	5.52	.0001	.0042	1.02	.0587	.0001	.2028	1.7	.0076

Odor, none. On heating, Nos. 14527 and 15453 had a faintly vegetable odor. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

No. 13878. Fungi, *Crenothrix*, 1. Miscellaneous, *Zoöglœa*, 10. Total, 11.
No. 15453. Fungi, *Crenothrix*, 5; *Molds*, 14. Miscellaneous, *Zoöglœa*, 2. Total, 21.
In the other samples no organisms were found.

Water Supply of Fall River.

Chemical Examination of Water from North Watuppa Lake.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13879	Feb. 25	Slight.	Slight.	.40	3.30	0.95	.0012	.0186	.0162	.0024	.62	.0030	.0001	.4700	0.8
14202	Apr. 23	Slight.	Slight.	.23	3.20	1.10	.0012	.0230	.0188	.0042	.58	.0000	.0000	.4621	0.8
14346	May 22	Slight.	Slight.	.25	3.70	1.45	.0000	.0158	.0132	.0026	.57	.0000	.0000	.4294	0.5
Av.	....	....	....	.29	3.40	1.17	.0008	.0191	.0161	.0030	.59	.0010	.0000	.4538	0.7

Odor, vegetable. —— The first sample was collected from a faucet in the city, the second from a faucet at the pumping station, and the last from the gate-house at the lake.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 13879, 609; No. 14202, 229; No. 14346, 228.

FITCHBURG.

Water Supply of Fitchburg.

Chemical Examination of Water from Scott Reservoir, Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13850	Feb. 19	V. slight.	Slight, fibrous.	.10	3.35	1.10	.0016	.0188	.0144	.0044	.26	.0050	.0000	.2980	0.3
14316	May 16	Distinct.	Slight.	.15	2.35	1.20	.0002	.0162	.0122	.0040	.17	.0000	.0000	.2765	0.5
14876	Aug. 20	Decided	Cons., green.	.10	2.50	1.20	.0002	.0208	.0136	.0072	.19	.0000	.0000	.4290	0.5
15576	Nov 19	Slight.	Slight.	.30	2.80	1.10	.0008	.0256	.0186	.0070	.18	.0030	.0000	.4485	0.3
Av.	....	....	....	.16	2.75	1.15	.0007	.0203	.0147	.0056	.20	.0020	.0000	.3630	0.4

Averages by Years.

-	1887*	-	-	.30	2.63	1.01	.0007	.0231	-	-	.15	.0021	-	-	-
-	1888	-	-	.11	2.31	0.79	.0004	.0240	-	-	.13	.0040	.0001	-	-
-	1889	-	-	.09	2.12	0.62	.0008	.0213	.0162	.0051	.13	.0030	.0001	-	-
-	1890	-	-	.10	2.54	1.02	.0010	.0217	.0152	.0065	.13	.0059	.0001	-	0.9
-	1891	-	-	.13	2.55	1.05	.0007	.0146	.0110	.0036	.14	.0082	.0000	-	0.6
-	1892	-	-	.13	2.78	1.16	.0005	.0261	.0198	.0063	.18	.0089	.0000	-	0.5
-	1893	-	-	.10	2.68	1.30	.0001	.0233	.0162	.0071	.17	.0033	.0000	.2870	0.4
-	1894	-	-	.14	2.54	1.01	.0007	.0191	.0143	.0048	.18	.0018	.0001	.2785	0.2
-	1895	-	-	.16	2.75	1.15	.0007	.0203	.0147	.0056	.20	.0020	.0000	.3630	0.4

* June to December.

Note to analyses of 1895: Odor, vegetable, and occasionally also unpleasant or mouldy. —— The samples were collected from the reservoir. The heights of water in this reservoir on dates when samples of water were collected for analysis were as follows: February 19, 25 feet; May 16, 38 feet; August 20, 21 feet; November 19, 25 feet.

FITCHBURG.

Microscopical Examination of Water from Scott Reservoir, Fitchburg.

[Number of organisms per cubic centimeter.]

	1895.			
	Feb.	May.	Aug.	Nov.
Day of examination,	20	17	21	20
Number of sample,	13850	14316	14876	15576
PLANTS.				
Diatomaceæ,	**0**	**493**	**8,557**	**755**
Asterionella,	0	76	4	4
Cocconeis,	0	0	0	4
Cyclotella,	0	0	3	1
Diatoma,	0	0	124	0
Melosira,	0	208	33	676
Navicula,	0	1	1	0
Synedra,	0	160	8,272	12
Tabellaria,	0	48	120	58
Cyanophyceæ,	**0**	**0**	**5**	**2**
Chroöcoccus,	0	0	0	2
Merismopedia,	0	0	5	0
Algæ,	**0**	**14**	**76**	**40**
Arthrodesmus,	0	0	56	0
Cosmarium,	0	0	0	32
Protococcus,	0	12	0	2
Raphidium,	0	0	11	4
Scenedesmus,	0	1	0	2
Staurastrum,	0	0	7	0
Zoöspores,	0	1	2	0
ANIMALS.				
Infusoria,	**32**	**421**	**141**	**8**
Dinobryon,	0	0	2	0
Dinobryon cases,	0	420	0	0
Monas,	0	0	2	0
Peridinium,	32	1	136	8
Trachelomonas,	0	0	1	0
Vermes,	**1**	**7**	**2**	**4**
Anurea,	0	4	1	0
Polyarthra,	1	1	0	0
Rotifer,	0	2	0	4
Triarthra,	0	0	1	0
Miscellaneous, Zoöglœa,	**0**	**0**	**24**	**44**
TOTAL,	33	935	8,805	853

FITCHBURG.

Chemical Examination of Water from Meeting-house Pond, Westminster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
13676	Jan. 15	V. slight.	V. slight.	.10	2.50	0.85	.0018	.0150	.0140	.0010	.24	.0060	.0000	.2251	0.8
14026	Mar. 20	V. slight.	Cons.	.05	2.40	0.85	.0026	.0140	.0126	.0014	.20	.0030	.0000	.2172	0.9
14315	May 16	Slight.	Slight.	.10	2.60	0.95	.0012	.0140	.0120	.0020	.14	.0000	.0000	.2291	0.9
14668	July 22	Slight.	Slight.	.10	2.50	0.80	.0000	.0144	.0130	.0014	.18	.0000	.0000	.2250	0.6
15193	Sept. 16	Slight.	Slight.	.08	2.30	0.80	.0000	.0172	.0154	.0018	.19	.0000	.0000	.2301	0.6
15577	Nov. 19	None.	V. slight.	.15	3.35	1.30	.0014	.0118	.0108	.0010	.24	.0070	.0000	.8346	1.1
Av.	....	... .	....	.10	2.61	0.92	.0012	.0144	.0130	.0014	.20	.0027	.0000	.3268	0.8

Averages by Years.

-	1893	-	-	.07	2.37	0.88	.0009	.0137	.0113	.0024	.17	.0023	.0000	.2304	0.6
-	1894	-	-	.07	2.38	0.86	.0011	.0149	.0125	.0024	.18	.0026	.0000	.2162	0.6
-	1895	-	-	.10	2.61	0.92	.0012	.0144	.0130	.0014	.20	.0027	.0000	.3268	0.8

Note to analyses of 1895: Odor, generally faintly vegetable. —— The samples were collected from the pond as follows: The first sample near the shore north of the overflow; the second, just below dam; the remaining samples from the gate-house.

Microscopical Examination of Water from Meeting-house Pond, Westminster.

[Number of organisms per cubic centimeter.]

	1895.					
	Jan.	Mar.	May.	July	Sept.	Nov.
Day of examination,	17	21	17	24	19	20
Number of sample,	13676	14026	14315	14668	15193	15577
PLANTS.						
Diatomaceæ,	**2**	**10**	**59**	**52**	**12**	**0**
Cyclotella,	0	0	0	14	1	0
Fragilaria,	0	0	0	13	0	0
Synedra,	2	7	40	19	7	0
Tabellaria,	0	3	19	6	4	0

FITCHBURG.

Microscopical Examination of Water from Meeting-house Pond, Westminster — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Mar.	May.	July.	Sept.	Nov.
PLANTS — Con.						
Cyanophyceæ,	0	0	0	1	54	32
Merismopedia,	0	0	0	0	32	0
Microcystis,	0	0	0	1	22	0
Oscillaria,	0	0	0	0	0	32
Algæ,	8	0	75	33	78	0
Arthrodesmus,	0	0	2	1	0	0
Glœocapsa,	0	0	0	0	10	0
Protococcus,	8	0	73	15	27	0
Raphidium,	0	0	0	17	38	0
Staurogenia,	0	0	0	0	3	0
Fungi, Crenothrix,	pr.	1	0	0	0	0
ANIMALS.						
Infusoria,	1	384	319	4	24	0
Dinobryon,	0	168	0	0	0	0
Dinobryon cases,	1	0	312	0	24	0
Mallomonas,	pr.	0	1	0	0	0
Peridinium,	pr.	0	4	3	0	0
Trachelomonas,	0	216	1	0	0	0
Vermes, Anurea,	0	0	1	1	0	1
Miscellaneous, Zoöglœa,	0	0	60	0	0	0
TOTAL,	11	395	513	90	168	33

Water Supply of Foxborough Water Supply District, Foxborough.

Chemical Examination of Water from the Tubular Wells of the Foxborough Water Supply District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
14580	1895. July 8	None.	None.	.00	3.20	.0000	.0002	.36	.0400	.0000	.0000	0.8	.0000

Odor, none. —— The sample was collected from a faucet at the pumping station while pumping.

Microscopical Examination.

No organisms.

FRAMINGHAM.

Water Supply of Framingham. — Framingham Water Company.

Chemical Examination of Water from the Filter-gallery of the Framingham Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13872	Feb. 20	None.	None.	.03	7.40	.0042	.0044	.88	.0320	.0000	.0608	3.1	.0210
14347	May 22	V. slight.	Cons.	.02	7.20	.0000	.0072	.98	.0070	.0000	.0874	3.0	.0020
14860	Aug. 19	Slight.	Slight.	.08	7.40	.0026	.0038	.91	.0330	.0001	.0702	2.7	.0250
15614	Nov. 26	None.	None.	.04	7.30	.0014	.0044	.92	.0200	.0001	.0468	3.2	.0040
Av.	....	....	....	.04	7.32	.0020	.0049	.92	.0230	.0000	.0663	3.0	.0130

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia, Free.	Ammonia, Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1887*	-	-	.08	5.82	.0031	.0124	.43	.0123	-	-	-	-
-	1888	-	-	.10	5.81	.0027	.0081	.44	.0308	.0004	-	-	-
-	1889	-	-	.00	6.18	.0031	.0050	.56	.0366	.0002	-	-	-
-	1890	-	-	.00	7.09	.0020	.0039	.65	.0631	.0001	-	3.0	-
-	1891	-	-	.00	6.25	.0023	.0035	.63	.0707	.0001	-	2.8	-
-	1892†	-	-	.13	5.43	.0051	.0081	.39	.0225	.0018	-	2.6	-
-	1893	-	-	.04	6.07	.0026	.0033	.62	.0460	.0001	.1104	2.6	.0099
-	1894	-	-	.03	6.75	.0025	.0043	.79	.0515	.0001	.0796	2.8	.0272
-	1895	-	-	.04	7.32	.0020	.0049	.92	.0230	.0000	.0663	3.0	.0130

* June to November. † Two samples in October.

Note to analyses of 1895: Odor of the second sample, unpleasant; of the others, none. —— The samples were collected from the filter-gallery.

Chemical Examination of Water from a Faucet in South Framingham, supplied from the Works of the Framingham Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13873	Feb. 20	Slight.	Slight.	.03	7.20	.0000	.0054	.87	.0150	.0000	.0640	3.1	.0300
14348	May 22	Slight, milky.	None.	.18	7.90	.0012	.0022	.94	.0000	.0000	.0479	2.9	.0700
14861	Aug. 19	Distinct, rusty.	Slight, rusty.	.50	6.60	.0002	.0024	.91	.0020	.0001	.0780	2.9	.1400
15615	Nov. 26	Distinct, milky.	V. slight.	.28	6.10	.0000	.0034	.90	.0030	.0001	.0507	3.0	.0370
Av.	....	....	....	.25	6.95	.0003	.0033	.90	.0050	.0000	.0601	3.0	.0692

Odor of the first sample, none, becoming very faintly vegetable on heating; of the second, distinctly unpleasant, disappearing on heating; of the third, decidedly tarry; of the last, none, becoming faintly tarry on heating.

FRAMINGHAM.

Chemical Examination of Water from the Underdrain beneath the Sewers at Framingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13654	Jan. 14	Slight.	Cons., floc.	.00	18.70	.0640	.0190	2.20	.3500	.0018	.0869	7.0	.0470
13819	Feb. 14	Slight.	Cons.	.00	19.20	.0560	.0180	2.00	.5500	.0019	.0592	7.3	.0170
13996	Mar. 19	Slight.	Cons., white.	.02	19.50	.0760	.0070	1.90	.4350	.0018	.0853	7.9	.0340
14474	June 14	Slight.	Cons., rusty.	.05	21.00	.0440	.0090	2.40	.4100	.0020	.0679	7.9	.0530
14616	July 15	Slight.	Slight, yellow.	.02	22.70	.0320	.0080	2.40	.5000	.0020	.0936	7.6	.0150
14670	July 22	Slight.	Slight.	.02	20.70	.0320	.0056	2.25	.4000	.0030	.0412	7.4	.0120
14800	Aug. 12	None.	Slight, rusty.	.02	23.50	.0480	.0040	2.60	.4050	.0021	.1014	7.9	.0300
15202	Sept. 17	Slight.	Slight.	.02	19.90	.0416	.0028	2.20	.4350	.0040	.0796	6.9	.0240
15383	Oct. 16	Distinct.	Cons., brown.	.01	21.70	.0480	.0040	2.50	.4600	.0010	.1030	8.3	.1080
15516	Nov. 12	Slight.	Slight.	.08	22.50	.0440	.0104	2.50	.3650	.0025	.1833	8.0	.0350
15719	Dec. 10	Distinct.	Slight.	.09	21.50	.0480	.0050	2.30	.3250	.0030	.0858	8.6	.0350
Av.*	....	....	....	.03	20.92	.0502	.0086	2.29	.4995	.0023	.0920	7.7	.0366

Averages by Years.

-	1889†	-	-	.00	19.70	.0800	.0080	3.73	.4750	.0045	-	6.6	-
-	1890	-	-	.01	19.71	.0824	.0073	3.51	.5336	.0026	-	8.4	-
-	1891	-	-	.01	20.44	.1029	.0045	3.51	.5333	.0019	-	8.0	-
-	1892	-	-	.01	19.32	.0805	.0042	3.99	.6667	.0018	-	8.0	-
-	1893	-	-	.02	20.75	.0829	.0039	3.84	.6282	.0014	.0645	7.4	-
-	1894	-	-	.00	22.24	.0620	.0033	3.61	.5315	.0028	.0850	7.1	-
-	1895	-	-	.03	20.92	.0502	.0086	2.29	.4995	.0023	.0920	7.7	.0366

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† October.

NOTE to analyses of 1895: Odor, frequently faintly earthy or musty, often none; on heating, sometimes unpleasant or disagreeable. —— The samples were collected from the underdrain at its outlet, with the exception of No. 15516, which was collected from a manhole.

The analysis of 1889 was made before sewage was admitted to the sewers. Several of the analyses made in 1890 and those of the years 1891 to 1894 inclusive were made by the city of Boston.

FRAMINGHAM.

Microscopical Examination of Water from the Underdrain beneath the Sewers at Framingham.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Mar.	June.	July.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	15	20	18	16	24	13	19	17	13	12
Number of sample,	13654	13819	13996	14474	14616	14670	14800	15202	15383	15516	15719
PLANTS.											
Fungi, Crenothrix,	3,280	1,776	1,680	640	720	156	440	13	36,800	296	880
Miscellaneous, Zoöglœa,	0	0	161	0	0	0	0	0	0	24	0
TOTAL,	3,280	1,776	1,841	640	720	156	440	13	36,800	320	880

WATER SUPPLY OF FRANKLIN. — FRANKLIN WATER COMPANY.

Chemical Examination of Water from the Wells of the Franklin Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13856	Feb. 20	None.	V. slight.	.63	7.85	.0004	.0094	.72	.1200	.0000	.4056	3.0	.0325
14520	June 21	V. slight.	V. slight.	.55	6.20	.0000	.0136	.51	.0700	.0002	.5544	2.1	.0200
14524	June 21	Slight.	Slight.	.60	5.60	.0000	.0126	.53	.0680	.0006	.5097	2.2	.0160
15404	Oct. 22	V. slight.	Slight.	.08	8.80	.0000	.0026	.96	.2750	.0000	.1131	3.8	.0070
Av.	....	....	....	.47	7.11	.0001	.0095	.63	.1332	.0002	.3957	2.8	.0189

Odor of the first and third samples, vegetable; of the others, none. —— The first three samples were collected from faucets in the town; the last sample, from a faucet in the pumping station.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 59.

GARDNER.

WATER SUPPLY OF GARDNER. — GARDNER WATER COMPANY.

Chemical Eamination of Water from Crystal Lake, Gardner.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13691	Jan. 18	V. slight.	V. slight.	.05	3.00	0.85	.0012	.0148	.0136	.0012	.34	.0030	.0000	.1698	1.3
14682	July 23	Distinct.	Cons.	.05	2.25	0.90	.0004	.0154	.0114	.0040	.33	.0000	.0000	.1275	1.3
15406	Oct. 22	V. slight.	Slight.	.05	3.00	1.15	.0008	.0274	.0260	.0014	.34	.0030	.0000	.1989	1.1
Av.	....	....	....	.05	2.75	0.97	.0008	.0192	.0170	.0022	.34	.0020	.0000	.1654	1.2

Averages by Years.

-	1887*	-	-	.02	2.63	0.62	.0006	.0111	-	-	.21	.0019	-	-	-
-	1888†	-	-	.01	2.60	0.62	.0023	.0112	-	-	.22	.0094	.0001	-	-
-	1891‡	-	-	.02	2.95	0.85	.0007	.0119	.0098	.0021	.16	.0073	.0001	-	0.7
-	1892§	-	-	.02	2.45	0.65	.0008	.0104	.0086	.0018	.27	.0180	.0000	-	1.1
-	1893	-	-	.05	2.65	0.82	.0012	.0126	.0105	.0021	.27	.0021	.0000	.1879	0.8
-	1894	-	-	.04	2.75	0.98	.0009	.0111	.0094	.0017	.31	.0023	.0000	.1464	1.0
-	1895	-	-	.05	2.75	0.97	.0008	.0192	.0170	.0022	.34	.0020	.0000	.1654	1.2

* June to December. † January to May. ‡ June, three samples. § March.

NOTE to analyses of 1895: Odor of the first and last samples, none, becoming distinctly vegetable on heating; of the second sample, distinctly vegetable, disappearing on heating. —— The first and second samples were collected from faucets in the town and the last from Crystal Lake.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 13691, 36; No. 14682, 293; No. 15406, 32. The number of *Cyanophyceæ* was as follows: No. 13691, 0; No. 14682, 76; No. 15406, 4.

GLOUCESTER.

Water Supply of Gloucester.

The works of the Gloucester Water Company were taken by the city Oct. 1, 1895.

The advice of the State Board of Health to the city of Gloucester, relative to its present and prospective sources of water supply, may be found on pages 20–23 of this volume. Analyses of samples of water collected during the investigation of the present supply and of the proposed sources of supply are given in the following tables.

Chemical Examination of Water from Dike's Brook Storage Reservoir, Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13763	Feb. 4	V.slight.	Slight.	.60	4.35	1.35	.0062	.0204	.0182	.0022	1.05	.0070	.0000	.5688	0.3
14426	June 4	Distinct.	Slight.	.30	3.85	1.30	.0024	.0188	.0150	.0038	0.97	.0050	.0000	.3443	0.2
14771	Aug. 6	Distinct.	Slight.	.50	4.35	1.50	.0000	.0216	.0192	.0024	0.97	.0100	.0000	.6408	0.8
14998	Sept. 3	Slight.	Slight.	.30	4.40	2.00	.0018	.0202	.0184	.0018	0.92	.0000	.0002	.4290	0.2
15491	Nov. 6	None.	V.slight.	.60	4.25	1.75	.0042	.0200	.0158	.0042	0.90	.0050	.0000	.4820	0.2
Av.	....	....	....	.46	4.24	1.58	.0029	.0202	.0173	.0029	0.96	.0054	.0000	.4930	0.3

Odor, vegetable; in June and November, also mouldy.——The samples were collected from the reservoir.

Microscopical Examination of Water from Dike's Brook Storage Reservoir, Gloucester.

[Number of organisms per cubic centimeter.]

	1895. Feb.	July.	Aug.	Sept.	Nov.
Day of examination,	6	7	8	7	8
Number of sample,	13763	14426	14771	14998	15491
PLANTS.					
Diatomaceæ,	0	9	85	0	1
Cyclotella,	0	2	1	0	0
Synedra,	0	7	84	0	1
Cyanophyceæ, Merismopedia,	0	0	10	0	0

GLOUCESTER.

Microscopical Examination of Water from Dike's Brook Storage Reservoir, Gloucester — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Feb.	July.	Aug.	Sept.	Nov.
PLANTS — Con.					
Algæ,	**0**	**344**	**4**	**12**	**35**
Cœlastrum,	0	0	0	0	27
Protococcus,	0	344	4	12	8
ANIMALS.					
Infusoria,	**0**	**0**	**2**	**4**	**0**
Dinobryon cases,	0	0	0	2	0
Peridinium,	0	0	0	1	0
Trachelomonas,	0	0	1	1	0
Vorticella,	0	0	1	0	0
Vermes,	**0**	**2**	**0**	**0**	**0**
Polyarthra,	0	1	0	0	0
Rotifer,	0	1	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**2**	**0**	**0**
TOTAL,	0	355	103	16	36

Chemical Examination of Water from Wallace Pond, Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13762	Feb. 4	Slight.	Slight.	.60	5.55	1.75	.0034	.0370	.0204	.0166	1.36	.0120	.0000	.6162	1.1
14425	June 4	Decided, green.	Cons., green.	.63	5.15	2.25	.0008	.0356	.0222	.0134	1.12	.0030	.0000	.6027	0.8
14770	Aug. 6	Decided.	Cons., green.	.70	5.35	2.25	.0006	.0452	.0258	.0194	1.15	.0160	.0001	.8424	1.1
14999	Sept. 3	Decided, green.	Cons., green.	.60	5.95	2.85	.0000	.0400	.0230	.0170	1.15	.0000	.0003	.7332	0.5
15490	Nov. 6	Distinct, green.	Cons., green.	.45	5.70	3.20	.0002	.0302	.0232	.0070	1.11	.0050	.0000	.7176	0.3
Av.	....	....	....	.60	5.54	2.46	.0010	.0376	.0229	.0147	1.18	.0072	.0001	.7024	0.8

Odor, distinctly vegetable and sometimes unpleasant. —— The samples were collected from Wallace Pond.

GLOUCESTER.

Microscopical Examination of Water from Wallace Pond, Gloucester.

[Number of organisms per cubic centimeter.]

	1895. Feb.	June.	Aug.	Sept.	Nov.
Day of examination,	6	7	8	7	8
Number of sample,	13762	14425	14770	14999	15490
PLANTS.					
Diatomaceæ,	4	52	0	0	0
Asterionella,	4	38	0	0	0
Synedra,	0	7	0	0	0
Tabellaria,	0	7	0	0	0
Algæ,	4	8	1,064	17,850	4,000
Chlorococcus,	0	0	0	50	0
Conferva,	0	0	1,040	17,600	4,000
Glœocapsa,	0	2	0	50	0
Pandorina,	0	0	24	0	0
Raphidium,	0	3	0	0	0
Scenedesmus,	0	3	0	0	0
Zoöspores,	4	0	0	150	0
ANIMALS.					
Infusoria,	173	500	228	700	13
Monas,	0	0	0	150	0
Paramæcium,	0	0	0	50	0
Peridinium,	172	500	228	450	0
Trachelomonas,	1	0	0	50	13
Vermes, Rotifer,	0	0	0	0	1
Miscellaneous, Zoöglœa,	0	28	106	0	136
TOTAL,	181	588	1,398	18,550	4,150

Chemical Examination of Water from a Faucet at City Hall, Gloucester, supplied from the Gloucester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
13786	1895. Feb. 6	None.	V.slight.	.60	4.25	1.55	.0006	.0138	.0134	.0004	1.05	.0070	.0000	.4977	0.5

Odor, very faintly vegetable.

Microscopical Examination.

Algæ, *Protococcus*, 30.

GLOUCESTER.

Chemical Examination of Water from Various Surface Water Sources in Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13756	Feb. 4	V.slight.	V.slight.	0.40	3.95	1.10	.0000	.0094	.0068	.0026	1.06	.0050	.0000	0.4068	0.5
13757	Feb. 4	Slight.	Slight.	1.80	7.25	3.10	.0042	.0300	.0268	.0032	1.27	.0050	.0000	2.0145	0.6
13758	Feb. 4	Slight.	Cons.	0.55	5.10	1.45	.0022	.0372	.0162	.0210	1.33	.0050	.0000	1.0428	0.6
13759	Feb. 4	V.slight.	Slight.	2.00	6.55	3.60	.0000	.0234	.0206	.0028	1.07	.0050	.0000	2.5676	0.8
13760	Feb. 4	V.slight.	Slight.	1.20	5.25	1.80	.0002	.0108	.0090	.0018	1.17	.0070	.0000	1.1850	0.3
13761	Feb. 4	V.slight.	V.slight.	1.40	5.50	2.35	.0004	.0178	.0158	.0020	1.03	.0030	.0000	1.6590	0.8

Odor of Nos. 13756, 13757, 13759 and 13761 faintly vegetable; of Nos. 13758 and 13760 distinctly vegetable. On heating, the odor of Nos. 13756, 13757 and 13759 was distinctly vegetable and unpleasant and of No. 13758 very disagreeable. —— No. 13756 was collected from Haskell's Brook just above the dam of Haskell's Reservoir; No. 13757, from Fernwood Lake at Homan's ice-house; No. 13758, from Lily Pond Brook near the pumping station of the Gloucester Water Company; No. 13759, from Norman's Woe Brook in Magnolia Swamp, about ¼ mile below Western Avenue; No. 13760, from a brook in Cedar Swamp near Bennett's Hill; No. 13761, from a brook in Cedar Swamp near Magnolia Avenue.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 13756, 1; No. 13757, 235; No. 13758, 363; No. 13759, 14; No. 13760, 4; No. 13761, 1.

Water Supply of Grafton. — Grafton Water Company.

Chemical Examination of Water from the Filter-gallery of the Grafton Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
14733	July 30	None.	V.slight.	.04	9.85	.0000	.0014	1.25	.2900	.0000	.0539	4.2	.0250
14951	Sept. 3	None.	None.	.00	9.80	.0000	.0014	1.11	.2200	.0002	.0346	3.2	.0030

Odor, none. —— The first sample was collected from a faucet at the office of the water company, and the second from the pump well at the pumping station.

Microscopical Examination.

No. 14733. Cyanophyceæ, *Oscillaria*, 2. Infusoria, *Peridinium*, 28. Total, 30.

No. 14951. Diatomaceæ, *Synedra*, 4. Algæ, *Scenedesmus*, 1. Infusoria, *Peridinium*, 5. Total, 10.

GREENFIELD.

WATER SUPPLY OF GREENFIELD.

In the early part of 1895 a pumping station was erected on the bank of Green River, in order to obtain an auxiliary supply from the river, but no water was drawn from this source for the supply of the town during the year.

The advice of the State Board of Health to the town of Greenfield, with reference to the use of Green River as a source of additional water supply for the town, may be found on pages 23 and 24 of this volume. Analyses of samples of water from this source may be found on page 382 of the annual report for 1894.

GROTON.

The advice of the State Board of Health to the town of Groton relative to a public water supply for the town may be found on pages 24 and 25 of this volume. Analyses of samples of water collected from various sources in the town, in connection with the investigations of the Board, are given in the following tables.

Chemical Examination of Water from Baddacook Pond, Groton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13934	Mar. 2	V. slight.	Slight.	.23	6.10	1.30	.0006	.0174	.0162	.0012	.20	.0100	.0001	.4528	2.7
14615	July 12	Slight.	Cons.	.30	5.40	1.60	.0006	.0206	.0182	.0024	.19	.0000	.0000	.5226	2.6
14762	Aug. 3	Distinct.	Cons.	.20	6.25	1.70	.0004	.0200	.0174	.0026	.21	.0050	.0000	.5772	3.2
15229	Sept. 21	Slight, green	Slight, green.	.25	5.90	1.70	.0012	.0202	.0186	.0016	.22	.0020	.0000	.4290	2.3
15431	Oct. 25	Distinct.	Slight.	.27	5.55	2.65	.0004	.0198	.0166	.0032	.20	.0050	.0000	.4953	2.6

Odor, generally faintly vegetable; in July, decidedly vegetable. —— The samples were collected from the pond near the surface, from 200 to 800 feet from the southerly shore.

GROTON.

Microscopical Examination of Water from Baddacook Pond, Groton.

[Number of organisms per cubic centimeter.]

	1895.				
	Mar.	July.	Aug.	Sept.	Oct.
Day of examination,	8	13	6	25	30
Number of sample,	13934	14615	14762	15229	15431
PLANTS.					
Diatomaceæ,	1	470	103	27	381
Asterionella,	0	308	11	4	68
Cyclotella,	0	146	88	1	100
Melosira,	0	5	0	4	24
Synedra,	0	1	0	0	5
Tabellaria,	1	10	4	18	184
Cyanophyceæ,	0	250	21	8	0
Anabæna,	0	6	0	0	0
Clathrocystis,	0	4	0	0	0
Microcystis,	0	240	21	1	0
Oscillaria,	0	0	0	7	0
Algæ,	0	87	84	4	21
Glœocapsa,	0	0	0	4	5
Protococcus,	0	81	72	0	14
Raphidium,	0	4	10	0	1
Scenedesmus,	0	2	2	0	1
Fungi, Crenothrix,	3	0	0	0	0
ANIMALS.					
Rhizopoda, Actinophrys,	0	0	0	0	1
Infusoria,	0	1	0	1	49
Dinobryon,	0	0	0	0	15
Dinobryon cases,	0	0	0	1	32
Mallomonas,	0	1	0	0	0
Peridinium,	0	0	0	0	1
Trachelomonas,	0	0	0	0	1
Miscellaneous, Zoöglœa,	0	0	0	28	80
TOTAL,	4	808	208	68	532

GROTON.

Chemical Examination of Water from Martin's Pond and from the Nashua River, Groton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13935	Mar. 2	Decided.	Cons.	.75	9.65	2.65	.1440	.0472	.0368	.0104	.25	.0030	.0000	.9971	4.6
14350	May 22	Distinct.	Cons.	.40	4.85	1.70	.0014	.0164	.0154	.0010	.40	.0170	.0003	.4028	1.6

Odor of the first sample, decidedly disagreeable; of the second, distinctly vegetable.—The first sample was collected from the pond; the last, from a tap supplied with water pumped from the Nashua River.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 13935, 171; No. 14350, 326.

Chemical Examination of Water from Cady Pond and a Spring near its Westerly Shore.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13937	Mar. 2	Distinct.	Cons.	.58	12.60	2.20	.0122	.0236	.0168	.0068	.18	.0000	.0008	.5698	6.7
14024	Mar. 20	Slight.	Cons.	.80	9.25	2.35	.0068	.0316	.0266	.0050	.19	.0230	.0003	.8785	4.3
13936	Mar. 2	V. slight.	Slight.	.01	12.50	0.50	.0000	.0028	.0014	.0014	.16	.0070	.0000	.0662	7.9
14023	Mar. 20	V. slight.	Cons.	.18	13.25	1.85	.0038	.0068	.0058	.0010	.15	.0170	.0002	.2449	7.7

Odor of the first two samples, distinctly vegetable and mouldy; of the others, none.—The first two samples were collected from the pond and the last two from the spring.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 307.

GROTON.

Chemical Examination of Water from a Spring and a Brook in Shattuck's Meadow, about One-fourth of a Mile west of Baddacook Pond.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
15430	Oct. 25	Slight.	Slight.	.02	6.20	.0000	.0062	.26	.0480	.0000	.1934	2.6	.0010
15442	Oct. 29	-	-	.10	-	-	-	.34	-	-	-	2.6	-

Odor of the first sample, none, becoming faintly vegetable on heating; odor of the second sample not determined.—— The first sample was collected from a spring; the last, from a brook in the vicinity of the spring.

Microscopical Examination.

No. 15430. Diatomaceæ, *Diatoma*, 2. Algæ, *Zoöspores*, 1. Fungi, *Molds*, 4. Miscellaneous, *Zoöglœa*, 9. Total, 15.

Chemical Examination of Water from a Tubular Well at the Groton School, Groton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
14351	May 22	V. slight.	Slight.	.05	11.40	.0000	.0000	.20	.0000	.0000	.0099	5.9	.0370

Odor, none.—— The sample was collected from a faucet in the school.

Microscopical Examination.

Fungi, *Crenothrix*, 572.

Hatfield.

The advice of the State Board of Health to the town of Hatfield, with reference to taking a water supply from Running Gutter Brook in the westerly part of the town, may be found on pages 25 and 26 of this volume. The results of an analysis of a sample of water from this brook are given on the following page.

HATFIELD.

Chemical Examination of Water from Running Gutter Brook, Hatfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
13826	1895. Feb. 15	None.	Cons., earthy.	.08	3.95	0.85	.0000	.0026	.0012	.0014	.10	.0120	.0000	.1000	1.8

Odor, faintly vegetable. —— The sample was collected from the brook at the first road crossing above its junction with Broad Brook, and a short distance below the site of a proposed reservoir.

Microscopical Examination.

Diatomaceæ, *Cocconeis*, 1. Algæ, *Protococcus*, 1. Total, 2.

Water Supply of Haverhill.

In 1895 an additional supply of water was introduced into the city of Haverhill from East Meadow River in the north-easterly part of the city, and a storage reservoir was constructed upon the stream at Millvale, about half a mile from the point where it enters the Merrimack River.

The reservoir has an area of about 50 acres and a capacity of about 125,000,000 gallons. Its maximum depth at high water is 15 feet and its average depth 7 feet. It was thoroughly prepared for the storage of water by removing the soil, mud and vegetable matter from the area to be flowed.

The water from this source is pumped into the easterly end of Kenoza Lake through a 24-inch main about one mile in length, the surface of Kenoza Lake at high water being 18 feet above the high-water level of the Millvale Reservoir.

The watershed of East Meadow River tributary to the Millvale Reservoir has an area of 7.75 square miles, on which there is a very small population. There is one small pond on the watershed about 3 miles above the reservoir, and there is a considerable area of swamp in the vicinity of the river, a large portion being located within a short distance of the reservoir.

HAVERHILL.

Chemical Examination of Water from Crystal Lake, Haverhill.

[Parts per 100,000]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended					
	1895.														
13899	Feb. 27	None.	V. slight.	.02	3.65	1.20	.0016	.0160	.0150	.0010	.28	.0030	.0000	.3602	1.7
15443	Oct. 29	V. slight	V. slight.	.20	3.00	1.25	.0008	.0200	.0168	.0032	.32	.0000	.0000	.3604	1.3

Odor, faintly vegetable.—— The first sample was collected from a faucet at the office of the Haverhill water works, and the second from the lake.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: in February, 17; in November, 121.

Chemical Examination of Water from Kenoza Lake, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended					
	1895.														
13897	Feb. 27	V. slight	V. slight.	.10	4.35	1.15	.0010	.0184	.0174	.0010	.46	.0000	.0000	.2828	2.1
15444	Oct. 29	V. slight.	V. slight.	.08	3.60	1.20	.0000	.0170	.0156	.0014	.42	.0000	.0000	.2262	1.9

Odor, vegetable. —— The samples were collected from the lake.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: in February, 1; in October, 184.

HAVERHILL.

Chemical Examination of Water from Lake Saltonstall, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
13898	Feb. 27	None.	V. slight.	.05	6.00	1.25	.0068	.0168	.0148	.0020	.78	.0030	.0001	.2354	2.7
15446	Oct. 29	Slight.	Slight.	.09	5.90	1.75	.0000	.0192	.0168	.0024	.76	.0000	.0000	.1888	2.5

Odor, vegetable.——The samples were collected from the lake, which is also known as Plug Pond.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: in February, 7; in October, 464.

Chemical Examination of Water from Lake Pentucket, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
13896	Feb. 27	None.	V. slight.	.04	4.65	1.05	.0006	.0198	.0190	.0008	.49	.0030	.0000	.2528	2.2
15445	Oct. 29	Slight.	Slight.	.07	3.95	1.35	.0004	.0198	.0176	.0022	.49	.0000	.0000	.2418	1.8

Odor, vegetable.——The samples were collected from the lake, which is also known as Round Pond.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: in February, 2; in October, 24.

HAVERHILL.

Chemical Examination of Water from East Meadow River, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
14134	Apr. 17	V. slight.	Slight.	1.10	4.45	2.15	.0000	.0192	.0180	.0012	.30	.0000	.0000	.9740	1.4
14739	July 30	V. slight.	V. slight.	0.40	5.00	1.55	.0000	.0118	.0106	.0012	.30	.0070	.0000	.3927	3.0

Odor of the first sample, very faintly vegetable; of the second, decidedly vegetable. —— The first sample was collected from the river just above the point where it crosses Millville Road, about half a mile from its mouth. The second sample was collected from the river at Thompson's bridge, just above the reservoir.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: in April, 1; in July, 44.

Water Supply of Hingham and Hull. — Hingham Water Company.

Chemical Examination of Water from Accord Pond, Hingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
14030	Mar. 20	V. slight.	Slight.	.25	3.15	1.35	.0016	.0130	.0116	.0014	.70	.0000	.0000	.3713	0.3
14512	June 19	Distinct.	Slight.	.22	3.15	1.50	.0000	.0138	.0122	.0016	.64	.0180	.0000	.3136	0.2
15221	Sept. 19	V. slight.	V. slight.	.12	4.50	1.20	.0000	.0108	.0094	.0014	.68	.0030	.0000	.1911	0.5
15739	Dec. 16	V. slight.	Slight.	.30	3.20	1.45	.0016	.0166	.0154	.0012	-	.0230	.0000	.3758	0.3
Av.	....	....	....	.22	3.50	1.37	.0008	.0135	.0121	.0014	.67	.0110	.0000	.3129	0.3

Odor of the first three samples, vegetable; of the last, none. —— The samples were collected from the pond.

HINGHAM AND HULL.

Microscopical Examination of Water from Accord Pond, Hingham.

[Number of organisms per cubic centimeter.]

	1895.			
	March.	June.	September.	December.
Day of examination,	21	21	21	18
Number of sample,	14030	14512	15221	15739
PLANTS.				
Diatomaceæ,	31	94	87	48
Asterionella,	19	0	24	0
Cyclotella,	12	80	0	3
Fragilaria,	0	0	2	1
Melosira,	0	7	60	39
Synedra,	0	6	1	4
Tabellaria,	0	1	0	1
Cyanophyceæ,	0	2	27	0
Anabæna,	0	2	0	0
Merismopedia,	0	0	4	0
Microcystis,	0	0	23	0
Algæ, Raphidium,	0	0	6	0
ANIMALS.				
Rhizopoda,	0	1	0	1
Actinophrys,	0	0	0	1
Arcella,	0	1	0	0
Infusoria,	426	16	0	2
Codonella,	0	0	0	2
Dinobryon,	166	9	0	0
Dinobryon cases,	256	0	0	0
Peridinium,	4	7	0	0
Vermes,	0	3	0	0
Anurea,	0	2	0	0
Rotatorian ova,	0	1	0	0
Miscellaneous, Zoöglœa,	0	0	0	20
TOTAL,	457	116	120	71

HINGHAM AND HULL.

Chemical Examination of Water from Fulling Mill Pond, Hingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14031	Mar. 20	V. slight.	Cons.	.23	4.20	1.40	.0006	.0088	.0074	.0014	.60	.0170	.0000	.2449	1.3
14511	June 19	Decided, green	Cons., dark.	.18	4.90	1.40	.0000	.0164	.0108	.0056	.78	.0180	.0000	.3081	1.4
15222	Sept. 19	Distinct, green.	Slight, green.	.12	4.30	1.25	.0008	.0110	.0082	.0028	.71	.0150	.0000	.2824	1.3
15777	Dec. 18	V. slight.	V. slight.	.20	5.30	1.05	.0030	.0068	.0050	.0018	.78	.0170	.0000	.1540	1.3
Av.	....	....	....	.18	4.67	1.27	.0011	.0107	.0078	.0029	.72	.0167	.0000	.2473	1.3

Odor, vegetable. —— The samples were collected from the pond.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14031, 15; No. 14511, 1,388, chiefly Actinophrys; No. 15222, 378; No. 15777, 8.

Chemical Examination of Water from Tubular Test Wells in Hingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14758	Aug. 2	Slight, milky.	Slight, sandy.	-*	14.40	.0040	.0012	1.70	.0050	.0000	.0936	8.6	.0700
14848	Aug. 15	Decided, milky.	Cons., rusty.	.10†	7.50	.0000	.0000	0.62	.0000	.0000	.0702	3.2	.5000
14903	Aug. 23	Slight.	Slight, white.	.03	5.60	.0000	.0000	0.88	.0070	.0000	.0078	1.3	.0070

* Milky at first; a few hours later, 0.25.

† This determination was made after the water had been filtered through filter-paper.

Odor, none. —— The samples were collected from tubular test wells in Hingham, located as follows: No. 14758, in the valley of Weir River, just above Union Street; No. 14848, at the junction of two brooks above High Street; No. 14903, beside a pond on South Pleasant Street.

Microscopical Examination.

No organisms.

HINSDALE.

Water Supply of Hinsdale Fire District, Hinsdale.

Chemical Examination of Water from the Storage Reservoir of the Hinsdale Fire District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13688	Jan. 17	Distinct.	V slight.	.45	3.55	1.35	.0000	.0212	.0154	.0058	.09	.0000	.0000	.4740	0.9
13865	Feb. 20	None.	V. slight.	.15	2.15	0.70	.0000	.0130	.0090	.0040	.10	.0070	.0000	.3058	0.5
13866	Feb. 20	None.	V slight.	.15	2.25	1.00	.0002	.0124	.0110	.0014	.08	.0050	.0000	.2855	0.5
14027	Mar. 20	V. slight.	V. slight.	.28	3.20	1.20	.0056	.0160	.0134	.0026	.07	.0000	.0001	.4700	1.1
14374	May 27	Slight.	Slight.	.12	2.50	0.95	.0002	.0106	.0090	.0016	.07	.0000	.0000	.2660	0.9
14547	June 26	Distinct.	Cons.	.20	3.05	1.25	.0000	.0184	.0094	.0090	.05	.0000	.0000	.3426	0.0
14724	July 29	Decided.	Cons.	.18	3.00	1.90	.0000	.0276	.0170	.0106	.11	.0030	.0002	.5852	0.2
15270	Sept. 26	Decided, green.	Slight, green.	.65	4.55	3.05	.0004	.0318	.0206	.0112	.08	.0030	.0000	.7410	0.6
15447	Oct. 29	Decided, green.	Cons., green.	.75	5.20	3.65	.0000	.0542	.0340	.0202	.08	.0000	.0000	.9477	0.6
15623	Nov. 26	Decided, green.	Cons., green.	.40	2.70	1.55	.0000	.0444	.0160	.0284	.07	.0000	.0000	.6006	0.2
15794	Dec. 23	Distinct.	Slight.	.35	2.80	1.45	.0008	.0338	.0202	.0136	.06	.0000	.0000	.5082	0.2
Av.*	....	....	....	.35	3.27	1.72	.0002	.0271	.0165	.0106	.08	.0012	.0000	.5231	0.5

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor, generally vegetable; in May, distinctly oily; on heating, sometimes unpleasant.——Nos. 13865, 13866, 14547 and 15623 were collected from the reservoir and the others from a faucet in the village.

Microscopical Examination of Water from the Storage Reservoir of the Hinsdale Fire District.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Feb.	Mar.	May	June.	July.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	19	23	23	21	28	28	31	28	31	27	26
Number of sample, ...	13688	13865	13866	14027	14374	14547	14724	15270	15447	15623	15794
PLANTS.											
Diatomaceæ, ...	**0**	**3**	**1**	**0**	**0**	**29**	**0**	**0**	**0**	**0**	**0**
Synedra, ...	0	3	1	0	0	20	0	0	0	0	0
Tabellaria, ...	0	0	0	0	0	9	0	0	0	0	0
Algæ, ...	**422**	**32**	**0**	**0**	**1**	**57**	**400,002**	**250,000**	**160,000**	**180,000**	**29,200**
Glœocapsa, ...	0	0	0	0	1	9	2	0	0	0	0
Palmella, ...	420	0	0	0	0	48	400,000	250,000	160,000	180,000	29,200
Protococcus, ...	2	32	0	0	0	0	0	0	0	0	0
Fungi, Crenothrix, ...	**0**	**0**	**0**	**0**	**12**	**28**	**0**	**0**	**0**	**0**	**0**

HINSDALE.

Microscopical Examination of Water from the Storage Reservoir of the Hinsdale Fire District — Concluded.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Feb.	Mar.	May.	June.	July.	Sept.	Oct.	Nov.	Dec.
ANIMALS.											
Infusoria,	**51**	**13**	**4**	**42**	**226**	**276**	**4**	**0**	**0**	**600**	**600**
Ciliated infusorian,	0	0	0	0	0	0	0	0	0	550	0
Cryptomonas,	40	0	0	1	0	0	0	0	0	0	0
Dinobryon,	0	0	0	1	4	0	0	0	0	0	0
Dinobryon cases,	0	0	3	0	216	0	0	0	0	0	0
Euglena,	1	4	0	1	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	0	0	50	0
Peridinium,	8	9	1	38	6	276	2	0	0	0	600
Trachelomonas,	2	0	0	1	0	0	2	0	0	0	0
Vermes, Polyarthra,	**0**	**6**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**
TOTAL,	473	54	5	42	239	390	400,008	250,000	160,000	180,600	29,800

WATER SUPPLY OF HOLBROOK.

(See *Randolph*)

HOLDEN.

The advice of the State Board of Health to the town of Holden with reference to the introduction of a water supply into that town from sources in the towns of Rutland and Holden may be found on pages 28 and 29 of this volume. The results of an analysis of a sample of water from Pine Hill reservoir in Holden are given below. Analyses of water from Muschopauge Pond in Rutland may be found under Rutland.

Chemical Examination of Water from Pine Hill Reservoir, Holden.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
13769	Feb. 5	V. slight.	V. slight.	.25	4.00	.85	.0042	.0126	.0110	.0016	.17	.0280	.0000	.3831	1.4

Odor, none, becoming distinctly vegetable on heating.

Microscopical Examination.

Diatomaceæ, *Epithemia*, 1. Infusoria, *Dinobryon*, 4; *Dinobryon cases*, 3. Miscellaneous, *Zoöglœa*, 1. Total, 9.

HOLLISTON.

WATER SUPPLY OF HOLLISTON.—HOLLISTON WATER COMPANY.

Chemical Examination of Water from the Works of the Holliston Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13624	Jan. 8	Slight.	Slight.	.23	5.50	.0020	.0092	.35	.0230	.0000	.2418	1.7	.0140
13890	Feb. 26	None.	V. slight.	.42	4.15	.0034	.0096	.32	.0130	.0000	.3223	1.3	.0110
14111	Apr. 9	V. slight.	V. slight.	.12	4.60	.0000	.0038	.30	.0240	.0000	.1709	1.9	.0100
14281	May 13	Distinct.	Slight.	.30	3.70	.0008	.0152	.30	.0050	.0000	.4226	1.3	.0125
14449	June 11	None.	V. slight.	.32	2.95	.0000	.0130	.25	.0050	.0000	.3214	1.3	–
14629	July 16	Slight, milky.	None.	.25	3.90	.0004	.0100	.25	.0050	.0001	.2340	1.1	–
14818	Aug. 13	None.	V. slight.	.12	4.15	.0000	.0090	.35	.0060	.0000	.2262	1.6	.0060
15128	Sept. 10	None.	None.	.05	4.90	.0000	.0036	.35	.0200	.0000	.1092	2.3	.0090
15333	Oct. 9	None.	V. slight.	.03	5.00	.0000	.0028	.34	.0150	.0000	.0484	2.5	.0040
15518	Nov. 12	Slight.	Slight.	.50	4.45	.0000	.0176	.34	.0080	.0000	.6146	1.4	–
15702	Dec. 10	V. slight.	V. slight.	.40	3.80	.0002	.0132	.26	.0050	.0000	.4540	1.4	–
Av.	....	....	....	.25	4.28	.0006	.0097	.31	.0117	.0000	.2878	1.6	.0095

Odor in January, August, September and October, none; at other times, vegetable, and in the last two samples, also mouldy. —— The samples collected in February, May and October were from faucets in the town and the others from a faucet at the pumping station while pumping, with the exception of No. 14629, which was collected when the pump had not been running for twenty-four hours.

Microscopical Examination of Water from the Works of the Holliston Water Company.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	28	10	14	12	17	14	11	10	13	11
Number of sample,	13624	13890	14111	14281	14449	14629	14818	15128	15333	15518	15702
PLANTS.											
Diatomaceæ,	1	1	8	12	1	22	0	1	1	9	0
Fragilaria,	0	0	1	0	0	12	0	1	0	5	0
Synedra,	1	1	7	12	pr.	5	0	pr.	1	3	pr.
Tabellaria,	pr.	0	0	0	1	5	0	0	0	1	0
Fungi, Crenothrix,	1	0	0	18	26	4	3	1	2	5	pr.
ANIMALS.											
Infusoria, Dinobryon cases,	0	0	1	5	3	0	2	1	0	2	0
TOTAL,	2	1	9	35	30	26	5	3	3	16	pr.

WATER SUPPLY OF HOLYOKE.

The advice of the State Board of Health to the city of Holyoke relative to a proposed additional water supply for the city may be found on pages 29 and 30 of this volume. Analyses of samples of water collected in connection with the investigation of the proposed sources of additional supply may be found on page 180.

Chemical Examination of Water from Whiting Street Storage Reservoir, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13709	Jan 23	Slight.	Slight.	.20	5.85	1.60	.0082	.0160	.0148	.0012	.18	.0070	.0000	.2646	3.4
13893	Feb. 26	None.	Slight.	.25	6.25	1.20	.0166	.0138	.0124	.0014	.19	.0080	.0003	.2860	3.6
14355	May 22	Slight.	Slight.	.18	4.35	1.65	.0000	.0174	.0120	.0054	.14	.0000	.0000	.2660	2.5
14535	June 24	Decided.	Cons., yellow.	.25	5.25	1.80	.0042	.0462	.0258	.0204	.14	.0000	.0001	.3835	2.7
15251	Sept. 24	Distinct.	Cons., brown.	.20	6.25	2.15	.0002	.0536	.0292	.0244	.12	.0080	.0000	.3666	3.4
15452	Oct. 30	Distinct, green.	Cons., green.	.20	5.70	1.80	.0006	.0402	.0292	.0110	.17	.0000	.0000	.4212	3.1
15783	Dec. 20	V. slight.	Cons.	.30	5.70	1.70	.0094	.0308	.0212	.0096	.15	.0070	.0000	.2911	3.1
Av.	....	....	....	.23	5.62	1.70	.0056	.0311	.0206	.0105	.16	.0043	.0001	.3256	3.1

Averages by Years.

From Brook before Reservoir was built.

-	1887*	-	-	.48	7.89	1.44	.0024	.0204	-	-	.13	.0126	-	-	-
-	1888	-	-	.25	6.63	1.22	.0009	.0183	-	-	.10	.0081	.0001	-	-
-	1889†	-	-	.14	6.72	1.02	.0006	.0134	.0092	.0042	.11	.0054	.0001	-	-

From Reservoir.

-	1890‡	-	-	.30	6.95	1.60	.0008	.0244	.0188	.0056	.15	.0120	.0000	-	3.6
-	1891	-	-	.41	6.34	2.05	.0125	.0311	.0253	.0058	.12	.0185	.0006	-	3.1
-	1892	-	-	.30	5.57	1.86	.0029	.0294	.0247	.0047	.14	.0192	.0001	-	2.8
-	1893	-	-	.18	4.67	1.63	.0008	.0251	.0183	.0068	.13	.0063	.0001	.3838	2.5
-	1894	-	-	.27	5.03	1.29	.0007	.0204	.0155	.0049	.16	.0067	.0000	.3343	2.9
-	1895	-	-	.23	5.62	1.70	.0056	.0311	.0206	.0105	.16	.0043	.0001	.3256	3.1

* June to December. † January to May. ‡ December.

NOTE to analyses of 1895: Odor of the first and last samples, none; of the others, vegetable.—— The samples were collected from the reservoir.

HOLYOKE.

Microscopical Examination of Water from Whiting Street Storage Reservoir Holyoke.

[Number of organisms per cubic centimeter.]

	1895.						
	Jan.	Feb.	May.	June.	Sept.	Nov.	Dec.
Day of examination,	24	28	24	26	26	1	24
Number of sample,	13709	13893	14355	14535	15251	15452	15783
PLANTS.							
Diatomaceæ,	**100**	**23**	**45**	**17,900**	**0**	**136**	**264**
Asterionella,	100	14	8	400	0	132	0
Diatoma,	0	8	0	0	0	0	0
Fragilaria,	0	0	37	17,500	0	2	4
Synedra,	0	1	0	0	0	2	260
Cyanophyceæ,	**0**	**0**	**0**	**2,450**	**2**	**25**	**1**
Anabæna,	0	0	0	2,450	0	0	0
Aphanocapsa,	0	0	0	0	0	20	1
Microcystis,	0	0	0	0	2	5	0
Algæ,	**0**	**0**	**16**	**0**	**2,465**	**79**	**198**
Chlorococcus,	0	0	12	0	0	0	0
Cosmarium,	0	0	0	0	276	1	0
Protococcus,	0	0	0	0	2,000	15	0
Raphidium,	0	0	0	0	20	9	36
Scenedesmus,	0	0	1	0	124	32	160
Staurastrum,	0	0	3	0	32	20	2
Staurogenia,	0	0	0	0	8	2	0
Zoöspores,	0	0	0	0	5	0	0
Fungi, Crenothrix,	**1**	**5**	**0**	**0**	**0**	**0**	**0**
ANIMALS.							
Infusoria,	**1**	**0**	**717**	**0**	**547**	**121**	**173**
Codonella,	0	0	0	0	3	0	0
Dinobryon,	0	0	68	0	0	0	0
Dinobryon cases,	0	0	648	0	0	0	0
Euglena,	0	0	0	0	1	0	5
Peridinium,	1	0	1	0	2	1	0
Tintinnidium,	0	0	0	0	1	0	0
Trachelomonas,	0	0	0	0	540	120	168
Vermes,	**1**	**2**	**1**	**0**	**4**	**1**	**0**
Anurea,	1	2	1	0	0	0	0
Polyarthra,	0	0	0	0	0	1	0
Rotatorian ova,	0	0	0	0	1	0	0
Rotifer,	0	0	0	0	3	0	0
Crustacea, Bosmina,	**0**	**0**	**0**	**0**	**.04**	**0**	**0**
Miscellaneous,	**0**	**2**	**108**	**0**	**12**	**20**	**80**
Acarina,	0	0	0	0	.20	0	0
Zoöglœa,	0	2	108	0	12	20	80
TOTAL,	103	32	887	20,350	3,030	382	716

HOLYOKE.

Chemical Examination of Water from Wright and Ashley Ponds, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13708	Jan. 23	Slight.	Slight.	.30	5.35	1.80	.0112	.0298	.0248	.0050	.26	.0070	.0001	.4226	2.9
13892	Feb. 26	V. slight.	V. slight.	.37	6.10	2.20	.0080	.0504	.0454	.0050	.25	.0180	.0001	.5253	3.2
14354	May 22	Slight.	Slight.	.05	5.35	1.40	.0006	.0116	.0106	.0010	.19	.0000	.0000	.1900	3.2
14534	June 21	Slight.	Slight.	.18	5.45	1.65	.0014	.0170	.0158	.0012	.17	.0000	.0000	.2772	2.7
15250	Sept. 24	V. slight.	V. slight.	.15	5.20	1.55	.0022	.0220	.0194	.0026	.16	.0050	.0000	.3237	2.9
15451	Oct. 30	Slight.	Slight.	.18	5.25	1.35	.0026	.0180	.0138	.0042	.16	.0030	.0001	.2730	3.1
15782	Dec. 20	V. slight.	V. slight.	.20	5.15	1.80	.0036	.0300	.0280	.0020	.16	.0070	.0001	.3426	2.9
Av.	....	....	....	.20	5.41	1.68	.0042	.0255	.0225	.0030	.19	.0057	.0001	.3363	3.0

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1887*	-	-	.08	5.25	0.89	.0029	.0202	-	-	.13	.0016	-	-	-
-	1888	-	-	.06	4.81	0.82	.0024	.0178	-	-	.12	.0054	.0001	-	-
-	1889	-	-	.02	5.37	0.74	.0020	.0201	.0161	.0040	.13	.0039	.0000	-	-
-	1890	-	-	.01	-	-	.0020	.0201	.0151	.0050	.13	.0048	.0000	-	-
-	1891†	-	-	.01	6.10	-	.0046	.0243	.0201	.0042	.13	.0035	.0001	-	2.9
-	1892‡	-	-	.02	5.10	1.15	.0008	.0196	.0154	.0042	.17	.0020	.0000	-	3.1
-	1893	-	-	.06	4.71	1.21	.0026	.0195	.0152	.0043	.15	.0072	.0000	.2466	3.1
-	1894	-	-	.09	5.14	1.33	.0022	.0215	.0179	.0036	.17	.0045	.0000	.2611	2.9
-	1895	-	-	.20	5.41	1.68	.0042	.0255	.0225	.0030	.19	.0057	.0001	.3363	3.0

* June to December. † July and October. ‡ May.

NOTE to analyses of 1895: Odor, vegetable. —— The samples were collected from Ashley Pond.

Microscopical Examination of Water from Wright and Ashley Ponds, Holyoke.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	May.	June.	Sept.	Nov.	Dec.
Day of examination,	24	28	24	26	26	1	24
Number of sample,	13708	13892	14354	14534	15250	15451	15782
PLANTS.							
Diatomaceæ,	**3**	**0**	**86**	**356**	**16**	**0**	**0**
Asterionella,	0	0	0	252	16	0	0
Cyclotella,	0	0	18	30	0	0	0
Fragilaria,	0	0	0	70	0	0	0
Melosira,	0	0	28	0	0	0	0
Synedra,	3	0	40	4	0	0	0

HOLYOKE.

Microscopical Examination of Water from Wright and Ashley Ponds, Holyoke — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	May.	June.	Sept.	Nov.	Dec.
PLANTS — Con.							
Cyanophyceæ,	0	0	0	13	260	0	0
Anabæna,	0	0	0	1	120	0	0
Chroöcoccus,	0	0	0	0	140	0	0
Microcystis,	0	0	0	12	0	0	0
Algæ,	0	0	13	51	30	0	0
Protococcus,	0	0	13	26	30	0	0
Staurogenia,	0	0	0	25	0	0	0
ANIMALS.							
Infusoria,	35	13	2	1	0	0	64
Ciliated infusorian,	0	0	1	0	0	0	0
Dinobryon cases,	0	0	0	1	0	0	0
Mallomonas,	5	0	0	0	0	0	0
Monas,	0	0	1	0	0	0	0
Peridinium,	29	12	0	0	0	0	64
Trachelomonas,	1	1	0	0	0	0	0
Miscellaneous, Zoöglœa,	2	15	60	0	0	0	0
TOTAL,	40	28	161	421	306	0	64

Chemical Examination of Water from Tucker and Manhan Brooks, Southampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14795	Aug. 9	V. slight.	V. slight.	.35	4.15	1.25	.0004	.0110	.0092	.0018	.16	.0020	.0000	.4758	1.1
14935	Aug. 28	None.	V. slight.	.12	3.80	0.80	.0014	.0036	.0030	.0006	.12	.0000	.0003	.1482	1.3
14796	Aug. 9	V. slight.	V. slight.	.15	4.70	1.15	.0014	.0048	.0040	.0008	.10	.0030	.0000	.3042	2.7
14934	Aug. 28	None.	V. slight.	.12	4.75	1.15	.0012	.0082	.0072	.0010	.16	.0000	.0002	.1560	2.2

Odor of the first sample, none; of the second, faintly vegetable, becoming stronger on heating; of the third, faintly mouldy; of the last, faintly vegetable, becoming stronger and also musty on heating. —— The first sample was collected from Tucker Brook, ½ mile above its junction with Manhan Brook; the second, from Tucker Brook, just above the junction; the third, from Manhan Brook, ½ mile above its junction with Tucker Brook; and the last, from Manhan Brook, just above the junction of the two brooks.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

Water Supply of Hudson.

Chemical Examination of Water from Gates Pond, Berlin.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended		Nitrates.	Nitrites.		
	1895.														
13621	Jan. 8	V. slight.	V. slight.	.04	2.45	0.95	.0006	.0240	.0152	.0088	.25	.0000	.0000	.2005	0.9
13800	Feb. 12	Slight.	Slight.	.05	2.85	0.85	.0002	.0260	.0172	.0088	.27	.0030	.0000	.3400	1.3
13962	Mar. 12	V. slight.	V. slight.	.02	2.20	0.55	.0016	.0132	.0116	.0016	.25	.0050	.0000	.1809	0.8
14150	Apr. 16	Distinct.	Slight.	.07	2.20	0.90	.0038	.0150	.0118	.0032	.20	.0020	.0000	.1935	1.0
14280	May 13	Slight.	Cons.	.04	2.55	0.75	.0020	.0150	.0126	.0024	.19	.0050	.0000	.1675	1.4
14466	June 12	Slight.	Slight.	.03	2.60	1.20	.0026	.0170	.0152	.0018	.17	.0000	.0000	.1755	0.8
14641	July 17	V. slight.	Slight.	.05	1.85	0.80	.0000	.0174	.0158	.0016	.22	.0000	.0000	.1237	0.6
14843	Aug. 15	Distinct.	Slight.	.03	2.70	0.85	.0000	.0162	.0140	.0022	.24	.0000	.0000	.1872	0.5
15126	Sept. 10	Slight.	Slight.	.03	2.25	1.20	.0004	.0164	.0152	.0012	.25	.0000	.0001	.2418	0.9
15349	Oct. 10	V. slight.	Slight.	.12	2.30	0.85	.0012	.0196	.0164	.0032	.22	.0050	.0000	.2246	0.8
15554	Nov. 15	Slight.	Slight.	.07	2.55	1.10	.0008	.0150	.0134	.0016	.25	.0050	.0000	.2067	0.9
15748	Dec. 17	V. slight.	V. slight.	.07	2.95	1.10	.0048	.0156	.0146	.0010	.29	.0070	.0000	.1963	1.1
Av.	....	....	....	.05	2.45	0.92	.0015	.0175	.0144	.0031	.23	.0027	.0000	.2032	0.9

Averages by Years.

-	1887*	-	-	.06	3.17	0.71	.0014	.0150	-	-	.21	.0054	-	-	-
-	1888	-	-	.06	2.55	0.69	.0015	.0158	-	-	.19	.0055	.0001	-	-
-	1889	-	-	.03	2.14	0.58	.0020	.0189	.0139	.0050	.19	.0048	.0001	-	-
-	1890	-	-	.02	2.82	1.04	.0023	.0161	.0124	.0037	.21	.0054	.0000	-	1.2
-	1891	-	-	.04	2.52	0.90	.0011	.0150	.0117	.0033	.20	.0074	.0000	-	0.9
-	1893	-	-	.05	2.45	1.01	.0040	.0178	.0146	.0032	.23	.0039	.0000	.1965	0.6
-	1894	-	-	.04	2.27	0.83	.0016	.0148	.0124	.0024	.22	.0008	.0000	.1452	0.6
-	1895	-	-	.05	2.45	0.92	.0015	.0175	.0144	.0031	.23	.0027	.0000	.2032	0.9

* June to December.

Note to analyses of 1895: Odor of the first four samples, decidedly disagreeable; of the others, faintly vegetable or none.——The samples were collected from the pond. For monthly height of water in this pond, see page 182.

HUDSON.

Microscopical Examination of Water from Gates Pond, Berlin.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	8	14	14	17	14	13	19	16	11	11	16	18
Number of sample, ...	13621	13800	13962	14150	14280	14466	14641	14843	15126	15349	15554	15748
PLANTS.												
Diatomaceæ, ...	0	1	0	109	47	6	3	21	2	48	315	40
Asterionella, ...	0	pr.	0	3	20	0	0	0	0	6	38	30
Cyclotella, ...	0	1	0	0	0	1	1	4	1	0	0	0
Fragilaria, ...	0	0	0	0	0	1	2	2	0	0	0	0
Melosira, ...	0	0	0	51	0	0	0	4	0	34	236	0
Navicula, ...	0	0	0	1	0	pr.	0	1	0	4	2	0
Synedra, ...	0	0	0	48	13	0	0	6	0	3	36	6
Tabellaria, ...	0	0	0	6	14	4	0	4	1	1	3	4
Cyanophyceæ, ...	0	0	0	0	0	189	85	196	52	72	4	0
Anabæna, ...	0	0	0	0	0	118	0	0	0	0	0	0
Merismopedia, ...	0	0	0	0	0	0	50	0	0	0	0	0
Microcystis, ...	0	0	0	0	0	71	35	196	52	72	4	0
Algæ, ...	0	pr.	0	2	15	9	463	109	8	28	29	0
Arthrodesmus, ...	0	0	0	1	5	1	2	0	0	0	1	0
Pediastrum, ...	0	0	0	0	0	0	0	9	0	0	0	0
Protococcus, ...	0	pr.	0	1	4	7	440	76	0	8	8	0
Raphidium, ...	0	0	0	0	0	1	21	18	7	19	20	0
Staurastrum, ...	0	0	0	0	6	0	0	0	1	1	0	0
Staurogenia, ...	0	0	0	0	0	0	0	6	0	0	0	0
ANIMALS.												
Infusoria, ...	106	9,355	0	37	110	0	37	3	15	19	20	3
Ceratium, ...	0	0	0	0	0	0	0	0	0	2	0	0
Codonella, ...	8	0	0	0	0	0	0	0	0	0	1	0
Cryptomonas, ...	54	4,800	0	0	0	0	0	0	0	0	0	0
Dinobryon, ...	40	300	0	23	0	0	34	0	0	0	0	0
Dinobryon cases, ...	0	4,200	0	12	104	0	0	0	2	1	17	1
Euglena, ...	0	2	0	0	0	0	0	0	0	0	0	0
Mallomonas, ...	0	50	0	0	0	0	3	0	0	1	0	0
Peridinium, ...	2	3	0	2	6	0	0	3	11	2	2	2
Trachelomonas, ...	2	pr.	0	0	0	0	0	0	2	13	0	0
Miscellaneous, Zoöglœa, . .	0	0	0	0	52	0	0	24	0	100	7	0
TOTAL, ...	106	9,356	0	148	224	204	588	353	77	267	375	43

Table showing Heights of Water in Gates Pond Each Month during 1895.

[High-water mark is 14 feet.]

DATE. — 1895.	Feet.	DATE. — 1895.	Feet.
Jan. 15, ...	9.8	July 15, ...	9.5
Feb. 15, ...	9.2	Aug. 15, ...	9.1
March 15, ...	9.2	Sept. 15, ...	8.5
April 15, ...	10.3	Oct. 15, ...	8.7
May 15, ...	10.5	Nov. 15, ...	9.3
June 15, ...	10.0	Dec. 15, ...	10.0

WATER SUPPLY OF HULL.

(See *Hingham.*)

WATER SUPPLY OF HYDE PARK AND MILTON. — HYDE PARK WATER COMPANY.

Chemical Examination of Water from the Wells of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
13659	Jan. 14	None.	None.	.02	5.10	.0046	.0042	1.53	.0750	.0000	.0774	4.2	.0030
13835	Feb. 18	V. slight.	V. slight.	.01	9.30	.0046	.0028	1.30	.0780	.0001	.0741	3.8	.0120
13993	Mar. 18	None.	None.	.00	9.15	.0038	.0016	1.18	.0900	.0001	.0790	4.4	.0075
14149	Apr. 15	None.	None.	.02	9.10	.0038	.0020	1.21	.1200	.0003	.0727	4.1	.0140
14307	May 15	None.	None.	.04	8.40	.0034	.0028	1.06	.1100	.0001	.0513	3.6	.0020
14488	June 18	None.	V. slight.	.04	9.60	.0032	.0026	1.04	.0900	.0000	.0484	3.6	.0000
14659	July 22	V. slight.	Slight.	.08	10.50	.0050	.0060	1.27	.1050	.0003	.1200	4.4	.0100
14894	Aug. 20	None.	Slight.	.05	11.90	.0074	.0040	1.33	.0900	.0001	.1014	3.9	.0670
15189	Sept. 17	Slight.	Slight, rusty.	.08	10.90	.0098	.0048	1.57	.0650	.0001	.1248	4.2	.0165
15371	Oct. 15	V. slight.	V. slight.	.03	11.00	.0132	.0040	1.74	.0780	.0002	.1373	4.7	.0190
15581	Nov. 19	V. slight.	V. slight.	.03	9.60	.0108	.0038	1.38	.0820	.0002	.0975	4.0	.0120
15760	Dec. 17	None.	Slight.	.04	8.80	.0060	.0040	1.10	.0580	.0002	.0808	3.6	.0160
Av.	....	....	....	.04	9.44	.0063	.0035	1.31	.0867	.0001	.0887	4.0	.0149

Averages by Years.

-	1887*	-	-	.00	6.67	.0004	.0012	0.82	.0699	-	-	-	-
-	1888	-	-	.00	6.06	.0001	.0023	0.75	.0641	.0002	-	-	-
-	1889†	-	-	.00	5.76	.0001	.0019	0.68	.0596	.0001	-	-	-
-	1890‡	-	-	.02	9.35	.0006	.0023	0.88	.0550	.0002	-	4.2	-
-	1891§	-	-	.03	9.10	.0000	.0040	0.96	.0675	.0002	-	3.6	-
-	1892‖	-	-	.00	7.20	.0004	.0035	0.99	.0500	.0004	-	3.0	-
-	1893	-	-	.02	8.62	.0031	.0032	1.19	.0879	.0002	.0976	3.7	.0112
-	1894	-	-	.03	9.68	.0040	.0039	1.37	.0843	.0001	.0880	3.9	.0175
-	1895	-	-	.04	9.44	.0063	.0035	1.31	.0867	.0001	.0887	4.0	.0149

* June to December. † January to May. ‡ February and August.
§ June and September. ‖ Two samples in July.

NOTE to analyses of 1895: Odor, generally none; in August, unpleasant; in October, faintly vegetable. —— The samples were collected from a faucet at the pumping station.

HYDE PARK AND MILTON.

Microscopical Examination of Water from the Wells of the Hyde Park Water Company.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	19	17	16	20	23	23	18	17	21	20
Number of sample,	13659	13835	13993	14149	14307	14488	14659	14894	15189	15371	15581	15760
PLANTS.												
Fungi,	**17**	**56**	**6**	**7**	**0**	**1**	**9**	**8**	**92**	**24**	**3**	**2**
Crenothrix,	17	56	6	7	0	1	9	8	28	24	3	2
Molds,	0	0	0	0	0	0	0	0	64	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**16**	**76**	**0**	**0**	**0**
TOTAL,	17	56	6	7	0	1	9	24	168	24	3	2

Chemical Examination of Water from a Faucet in Milton supplied from the Works of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13776	Feb. 7	None.	None.	.02	7.90	.0000	.0008	1.37	.1100	.0000	.0592	3.4	.0000
13947	Mar. 7	None.	None.	.00	9.60	.0006	.0016	1.46	.1500	.0000	.0423	3.9	.0000
14094	April 3	None.	None.	.00	9.30	.0006	.0024	1.25	.1200	.0000	.0423	3.8	.0030
14428	June 5	None.	None.	.00	10.90	.0002	.0034	1.32	.1300	.0000	.0266	3.8	.0020
14614	July 12	None.	None.	.05	10.80	.0002	.0030	1.43	.1600	.0001	.0869	4.6	.0000
15014	Sept. 6	None.	None.	.03	10.10	.0004	.0022	1.68	.1100	.0000	.1170	4.0	.0060
15317	Oct. 7	None.	None.	.01	10.10	.0000	.0020	1.79	.0800	.0000	.0764	4.0	.0080
15487	Nov. 6	None.	None.	.03	10.00	.0000	.0030	1.62	.0800	.0000	.0546	4.0	.0010
15675	Dec. 4	None.	None.	.03	7.90	.0000	.0016	1.56	.0750	.0000	.0741	3.4	.0050
Av.	....	....	....	.02	9.62	.0002	.0022	1.50	.1128	.0000	.0644	3.9	.0028

Odor, generally none. —— The samples were collected from a faucet in the office of the Milton Water Company.

Microscopical Examination.

No organisms were found in the samples collected in April, June, September and October. In the other samples small numbers of Crenothrix were fonnd, as follows: in February, 2; in March, 1; in July, 40; in November, 2; in December, 1.

HYDE PARK AND MILTON.

Chemical Examination of Water from the Neponset River at Hyde Park.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13658	Jan. 14	Distinct, milky.	Slight.	0.95	5.20	1.95	.0006	.0236	.0198	.0038	0.71	.0120	.0000	0.7884	1.6
13834	Feb. 18	Decided.	Cons., gray.	0.90	11.35	3.00	.0066	.0350	.0268	.0082	1.86	.0120	.0002	1.1583	3.4
13992	Mar. 18	Distinct.	Slight.	0.90	5.20	1.95	.0006	.0204	.0196	.0008	0.57	.0030	.0000	0.8279	2.2
14148	Apr. 15	Slight.	Slight.	1.20	5.20	2.40	.0014	.0280	.0244	.0036	0.64	.0000	.0000	1.0744	2.1
14306	May 15	Distinct.	Cons., brown.	1.50	7.05	2.90	.0030	.0420	.0360	.0060	0.66	.0030	.0002	1.3983	2.3
14487	June 18	Decided.	Cons., rusty.	1.10	13.65	3.40	.0258	.0522	.0398	.0124	1.90	.0030	.0000	1.0413	5.6
14658	July 22	Decided.	Heavy, rusty.	0.90	10.40	2.75	.0328	.0460	.0356	.0104	1.60	.0000	.0002	0.9000	4.0
14893	Aug 20	Distinct.	Cons., rusty.	0.73	9.25	2.85	.0752	.0362	.0312	.0050	1.42	.0000	.0001	0.6708	3.1
15188	Sept. 17	Slight.	Slight.	0.70	11.65	2.50	.0684	.0512	.0482	.0030	2.54	.0030	.0002	0.9826	5.1
15370	Oct. 15	Slight.	Cons.	1.10	8.30	3 95	.0004	.0504	.0426	.0078	0.88	.0120	.0003	1.3533	2.5
15580	Nov. 19	Slight.	Slight.	1.30	6.80	3.00	.0018	.0282	.0266	.0016	0.71	.0070	.0001	1.3338	1.9
15759	Dec. 17	Slight.	Slight.	1.15	6.75	3.10	.0022	.0244	.0232	.0012	0.64	.0220	.0002	1.0202	1.8
Av.	....	....	....	1.04	8.40	2.81	.0182	.0365	.0312	.0053	1.18	.0064	.0001	1.0458	3.0

Averages by Years.

-	1887*	-	-	1.19	8.35	2.30	.0053	.0400	-	-	0.99	.0080	-	-	-
-	1888	-	-	1.02	6.77	2.27	.0030	.0324	-	-	0.83	.0095	.0002	-	-
-	1891†	-	-	1.48	10.34	3.45	.0190	.0510	.0413	.0097	1.16	.0065	.0003	-	3.3
-	1892‡	-	-	0.90	13.30	2.85	.0260	.0324	.0286	.0038	2.31	.0090	.0012	-	4.4
-	1893	-	-	1.16	7.70	2.49	.0151	.0320	.0254	.0066	1.19	.0154	.0005	0.9548	2.4
-	1894	-	-	1.14	9.68	2.69	.0112	.0360	.0277	.0083	1.64	.0062	.0002	1.0003	3.0
-	1895	-	-	1.04	8.40	2.81	.0182	.0365	.0312	.0053	1.18	.0064	.0001	1.0458	3.0

* June to December. † August and September. ‡ July.

NOTE to analyses of 1895: Odor, generally decidedly vegetable and musty or disagreeable, and occasionally offensive.—— The samples were collected from the river, opposite the works of the Hyde Park Water Company. The river is not used directly as a source of water supply.

HYDE PARK AND MILTON.

Microscopical Examination of Water from the Neponset River at Hyde Park.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov	Dec.
Day of examination, ...	15	20	19	17	16	19	23	22	18	17	21	20
Number of sample, ...	13658	13834	13992	14148	14306	14487	14658	14893	15188	15370	15580	15759
PLANTS.												
Diatomaceæ, ...	7	2	7	67	85	21	4	28	2	88	4	1
Asterionella, ...	0	0	0	2	0	0	0	0	0	16	0	0
Ceratoneis, ...	0	0	0	3	5	0	0	0	0	0	0	0
Cyclotella, ...	0	1	0	0	17	12	0	7	0	6	0	0
Diatoma, ...	1	0	0	1	1	0	0	1	0	6	0	0
Fragilaria, ...	0	0	0	0	2	0	4	0	0	0	0	0
Melosira, ...	0	0	0	4	12	0	0	0	0	0	0	0
Navicula, ...	1	1	0	1	5	1	0	0	1	4	3	0
Synedra, ...	3	0	6	46	36	8	0	20	1	56	1	1
Tabellaria, ...	2	0	1	10	7	0	0	0	0	0	0	0
Cyanophyceæ, Microcystis, .	0	0	0	0	0	2	0	2	0	2	0	0
Algæ, ...	0	0	1	2	15	2	14	50	0	12	0	0
Glœocapsa, ...	0	0	0	0	4	0	0	12	0	0	0	0
Protococcus, ...	0	0	1	0	0	0	14	22	0	0	0	0
Raphidium, ...	0	0	0	0	2	0	0	0	0	8	0	0
Scenedesmus, ...	0	0	0	0	0	2	0	12	0	2	0	0
Zoöspores, ...	0	0	0	2	9	0	0	4	0	2	0	0
Fungi, Crenothrix, ...	44	140	5	6	608	484	9,600	56	44	30	228	7
ANIMALS.												
Infusoria, ...	2	0	3	12	9	0	14	44	1	8	0	0
Dinobryon, ...	0	0	0	3	0	0	0	0	0	0	0	0
Dinobryon cases, ...	0	0	0	3	0	0	0	0	0	0	0	0
Monas, ...	0	0	0	1	1	0	0	24	0	4	0	0
Peridinium, ...	2	0	3	4	1	0	6	13	1	0	0	0
Phacus, ...	0	0	0	0	0	0	0	0	0	2	0	0
Trachelomonas, ...	0	0	0	1	7	0	8	7	0	2	0	0
Vermes, Rotifer, ...	0	0	0	0	0	0	0	0	0	2	0	0
Miscellaneous, Zoöglœa, . .	184	1,440	26	60	68	840	0	48	96	120	60	80
TOTAL, ...	237	1,582	42	147	785	1,349	9,632	228	143	262	292	88

WATER SUPPLY OF IPSWICH.

Chemical Examination of Water from Dow's Brook above the Storage Reservoir of the Ipswich Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13604	Jan. 5	V.slight.	V.slight.	0.37	4.15	1.20	.0002	.0230	.0162	.0068	.58	.0040	.0000	.2707	1.9
13699	Jan 22	Slight.	Cons., dark.	0.70	4.70	1.75	.0006	.0142	.0124	.0018	.68	.0030	.0000	.6399	1.4
13882	Feb. 25	None.	Slight.	0.30	4.90	1.05	.0000	.0098	.0080	.0018	.62	.0080	.0000	.3334	1.8
14054	Mar.29	V. slight.	Cons.	0.60	4.05	1.35	.0000	.0138	.0120	.0018	.59	.0030	.0000	.5274	1.3
14210	Apr. 24	V. slight.	Slight.	0.53	4.00	1.80	.0004	.0102	.0092	.0010	.60	.0000	.0001	.5293	1.3
14372	May 27	V. slight.	Slight, brown.	0.53	5.00	1.60	.0000	.0120	.0104	.0016	.61	.0030	.0000	.5130	1.7
14530	June 24	Slight.	Slight, dark.	0.12	5.00	1.25	.0012	.0062	.0056	.0006	.58	.0080	.0000	.1679	1.8
14921	Aug.28	Distinct.	Slight.	0.20	5.40	1.75	.0006	.0082	.0068	.0014	.64	.0130	.0005	.2106	1.8
15266	Sept.25	Slight.	Slight.	0.22	5.30	1.75	.0020	.0250	.0230	.0020	.79	.0030	.0000	.3744	1.8
15449	Oct. 30	V.slight.	V. slight.	0.28	4.65	1.75	.0000	.0076	.0064	.0012	.62	.0000	.0000	.3416	2.3
15616	Nov.26	V. slight.	Slight.	1.00	4.75	2.15	.0000	.0150	.0116	.0034	.54	.0020	.0000	.8151	1.4
15800	Dec.23	V. slight.	V. slight.	0.90	4.70	1.90	.0004	.0152	.0142	.0010	.52	.0030	.0000	.7430	1.3
Av.*	....	....	....	0.47	4.74	1.62	.0005	.0129	.0111	.0018	.61	.0042	.0001	.4555	1.6

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor, generally faintly vegetable, sometimes none. The samples which had no odor when cold had vegetable odors when heated, and in the others the odors became stronger and sometimes also mouldy on heating —— The samples were collected from the brook at its entrance to the storage reservoir.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 42.

IPSWICH.

Chemical Examination of Water from the Dow's Brook Storage Reservoir of the Ipswich Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13605	Jan. 5	Distinct, milky.	Slight.	1.00	8.05	2.35	.0060	.0272	.0232	.0040	1.04	.0200	.0003	.8190	2.9
13700	Jan. 22	Slight, milky.	None.	0.62	6.30	1.95	.0006	.0172	.0146	.0026	0.97	.0100	.0000	.5609	2.2
13881	Feb. 25	V. slight	V. slight.	0.55	5.45	1.55	.0038	.0178	.0172	.0006	0.88	.0150	.0001	.5411	2.1
14055	Mar. 29	Slight.	Slight.	0.45	4.20	1.50	.0010	.0158	.0136	.0022	0.69	.0090	.0000	.4605	1.4
14211	Apr. 24	Distinct.	Cons., white.	0.45	4.20	1.80	.0008	.0146	.0120	.0026	0.67	.0070	.0002	.5253	1.4
14373	May 27	Slight.	Cons.	0.50	5.35	2.20	.0014	.0180	.0156	.0024	0.70	.0050	.0003	.5191	1.6
14531	June 24	Slight.	Slight, yellow.	0.25	5.10	1.75	.0030	.0170	.0152	.0018	0.76	.0000	.0000	.4297	1.7
14727	July 29	Slight.	Cons.	0.25	5.10	1.85	.0010	.0180	.0168	.0012	0.82	.0100	.0000	.3850	2.5
14922	Aug 28	Slight.	Slight.	0.18	5.25	2.65	.0014	.0206	.0170	.0036	0.80	.0000	.0001	.3276	1.9
15267	Sept 25	V. slight	Slight.	0.12	5.30	1.80	.0022	.0258	.0196	.0062	0.78	.0030	.0000	.3549	2.1
15450	Oct. 30	Slight.	Slight.	0.30	5.45	1.60	.0040	.0276	.0258	.0018	0.78	.0070	.0001	.4758	1.9
15617	Nov. 26	Slight.	Slight.	0.90	5.55	2.15	.0030	.0194	.0174	.0020	0.66	.0080	.0001	.7660	1.7
15801	Dec. 23	Slight.	Slight.	0.60	4.90	1.70	.0014	.0162	.0140	.0022	0.60	.0070	.0001	.5428	1.6
Av.*	....	....	....	0.45	5.25	1.89	.0022	.0194	.0169	.0025	0.76	.0072	.0001	.5015	1.9

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor, generally vegetable, often also mouldy or unpleasant, seldom none. On heating, frequently stronger and mouldy or unpleasant. —— The samples were collected from the reservoir.

When this reservoir was filled, in November, 1894, about 10,000,000 gallons of water from Bull Brook were diverted into it.

Microscopical Examination of Water from the Storage Reservoir of the Ipswich Water Works on Dow's Brook.

[Number of organisms per cubic centimeter.]

	1895.												
	Jan.	Jan.	Feb.	Apr	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Nov.	Dec.
Day of examination, . . .	8	23	28	2	26	28	25	31	29	28	1	27	27
Number of sample, . . .	13605	13700	13881	14055	14211	14373	14531	14727	14922	15267	15450	15617	15801
PLANTS.													
Diatomaceæ, . . .	**0**	**0**	**0**	**1**	**73**	**128**	**13**	**2**	**0**	**0**	**3**	**0**	**0**
Cyclotella, ...	0	0	0	0	1	0	8	0	0	0	0	0	0
Synedra, ...	0	0	0	1	72	128	5	2	0	0	3	0	0
Algæ, Protococcus, . .	**0**	**1**	**0**	**5**	**2**	**0**	**3**	**0**	**7**	**3**	**0**	**0**	**0**
Fungi, Crenothrix, . .	**0**	**2**	**0**	**4**	**1**	**132**	**0**	**0**	**0**	**2**	**19**	**1**	**0**

IPSWICH.

Microscopical Examination of Water from the Storage Reservoir of the Ipswich Water Works on Dow's Brook — Concluded.

[Number of organisms per cubic centimeter.]

	1895.												
	Jan.	Jan.	Feb	Apr.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Nov.	Dec.
ANIMALS.													
Infusoria,	**28**	**7**	**69**	**16**	**122**	**361**	**0**	**526**	**300**	**2**	**0**	**0**	**2**
Cryptomonas,	1	1	0	0	0	0	0	0	0	0	0	0	0
Dinobryon,	0	0	54	0	0	0	0	498	0	0	0	0	2
Dinobryon cases,	18	6	14	12	116	360	0	28	0	0	0	0	0
Peridinium,	9	0	1	4	6	1	0	0	300	2	0	0	0
Vermes, Rotatorian ova,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**
Crustacea, Cyclops,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.04**	**0**	**0**	**.04**	**0**
TOTAL,	28	10	69	26	198	621	16	528	311	7	22	1	2

Chemical Examination of Water from Bull Brook, Ipswich.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14053	Mar. 29	V. slight.	V. slight.	1.25	5.20	2.40	.0004	.0216	.0204	.0012	.60	.0090	.0000	1.0433	1.6

Odor, distinctly vegetable, becoming stronger on heating. —— The sample was collected from the brook, a short distance above its junction with Dow's Brook.

Microscopical Examination.

Diatomaceæ, *Melosira*, 3; *Meridion*, 9; *Synedra*, 3. Fungi, *Crenothrix*, 32. Total, 47.

Chemical Examination of Water from Faucets supplied from Ipswich Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13883	Feb. 25	Decided, milky.	V. slight.	.73	9.05	2.45	.0032	.0228	.0216	.0012	.97	.0200	.0003	.7252	2.9
14212	Apr. 24	Slight, milky.	V. slight.	.47	6.55	1.95	.0014	.0132	.0120	.0012	.78	.0170	.0003	.4858	2.6

Odor of the first sample, none, becoming distinctly vegetable and somewhat unpleasant on heating; of the second sample, faintly vegetable, becoming stronger and mouldy on heating. —— The samples were collected from faucets in the town.

Microscopical Examination.

No. 13883. Miscellaneous, *Zoöglœa*, 26.

No. 14212. Diatomaceæ, *Synedra*, 8. Algæ, *Protococcus*, 1. Fungi, *Crenothrix*, 1. Infusoria, *Peridinium*, 1. Total, 11.

IPSWICH.

Chemical Examination of Water from a Spring in Ipswich.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14371	May 27	None.	None.	.00	4.25	.0000	.0006	.94	.0550	.0000	.0228	2.7	.0000
14726	July 29	V. slight	Slight.	.03	6.55	.0000	.0014	.94	.0700	.0000	.0269	3.5	.0000

Odor, none. —— The samples were collected from a spring, located very near Dow's Brook, about 500 feet above the upper end of the Dow's Brook storage reservoir.

Microscopical Examination.

No. 14371. Diatomaceæ, *Meridion*, 6.
No. 14726. No organisms.

Water Supply of Kingston.

The advice of the State Board of Health to the town of Kingston with reference to the use of lead pipes in the distribution of the water supplied to the town may be found on pages 30 to 32 of this volume.

Chemical Examination of Water from a Faucet supplied from the Kingston Water Works.

[Parts per 100,000]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14763	Aug. 5	None.	V. slight.	.02	5.10	.0008	.0016	.76	.0730	.0019	.0624	1.8	.0050

Odor, very faintly vegetable.

Microscopical Examination.

Fungi, *Crenothrix*, 3.

Water Supply of Lawrence.

The following tables contain analyses of the unfiltered Merrimack River water, and of the filtered water at the pumping station and at the distributing reservoir. The results of more extended chemical and biological examinations of the water before and after filtration through the sand filter may be found in a subsequent portion of this report.

LAWRENCE.

Chemical Examination of Water from the Merrimack River above Lawrence, opposite the Intake of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13677	Jan. 16	Slight.	V. slight.	.40	4.70	1.40	.0124	.0224	.0198	.0026	.35	.0070	.0001	.4740	1.4
13862	Feb. 20	Distinct.	Slight.	.45	4.95	1.50	.0108	.0238	.0186	.0052	.35	.0100	.0003	.5070	1.6
14019	Mar. 20	Distinct.	Cons., floc.	.55	4.35	1.65	.0020	.0276	.0196	.0080	.22	.0050	.0002	.6320	1.4
14168	Apr. 17	Decided.	Heavy, earthy	.55	3.25	1.60	.0052	.0306	.0146	.0160	.29	.0030	.0001	.6399	0.5
14340	May 21	Distinct.	Slight.	.58	3.70	1.25	.0026	.0220	.0162	.0058	.23	.0070	.0001	.6478	1.3
14496	June 19	Decided.	Cons., brown	.40	4.25	2.15	.0060	.0320	.0174	.0146	.26	.0050	.0004	.4602	1.3
14698	July 24	Slight.	Cons.	.42	4.10	1.25	.0094	.0236	.0176	.0060	.36	.0070	.0003	.4928	1.8
14888	Aug 21	Distinct.	Slight.	.25	4.45	1.90	.0128	.0212	.0182	.0030	.30	.0030	.0002	.4056	1.6
15206	Sept. 18	Distinct.	Slight.	.28	4.90	1.65	.0108	.0208	.0176	.0032	.40	.0050	.0005	.3822	1.8
15384	Oct. 16	Slight, milky.	Slight, earthy.	.90	4.95	2.50	.0016	.0302	.0250	.0052	.29	.0130	.0002	.9766	1.7
15582	Nov. 20	Distinct.	Cons.	.90	4.05	2.40	.0000	.0226	.0206	.0020	.22	.0070	.0001	.9048	0.8
15771	Dec. 18	Slight, clayey.	Slight.	.48	4.45	1.70	.0028	.0218	.0170	.0048	.12	.0130	.0002	.5621	1.1
Av.	....	....	....	.51	4.34	1.75	.0064	.0249	.0185	.0064	.28	.0071	.0002	.5904	1.4

Averages by Years.

-	1887*	-	-	.47	4.82	1.24	.0027	.0211	-	-	.22	.0097	-	-	-
-	1888	-	-	.30	3.68	1.08	.0026	.0180	-	-	.18	.0094	.0002	-	-
-	1889	-	-	.30	3.09†	0.87†	.0030	.0176	.0144	.0032	.17	.0072	.0003	-	-
-	1890	-	-	.33	4.19‡	1.48‡	.0046	.0166	.0132	.0034	.17	.0089	.0001	-	1.6§
-	1891	-	-	.27	3.79	1.32	.0040	.0152	.0121	.0031	.18	.0110	.0001	-	1.3
-	1892	-	-	.43	4.12	1.47	.0042	.0181	.0152	.0029	.18	.0105	.0001	-	1.4
-	1893	-	-	.42	3.86	1.48	.0057	.0181	.0141	.0040	.20	.0081	.0002	.5295	1.1
-	1894	-	-	.37	3.70	1.30	.0062	.0167	.0141	.0026	.23	.0063	.0001	.4370	1.2
-	1895	-	-	.51	4.34	1.75	.0064	.0249	.0185	.0064	.28	.0071	.0002	.5904	1.4

* June to November. † January to May. ‡ August to December. § July to December.

NOTE to analyses of 1895: Odor, until May, decidedly musty and disagreeable; during the remainder of the year, distinctly vegetable and frequently also musty or unpleasant. —— The samples were collected from the river, opposite the intake of the Lawrence water works, about 1 foot beneath the surface. For a record of the quantity of water flowing in the river on dates when samples of water were collected for analysis, see page 195. For a comparison of the analyses of the river water at Lowell and Lawrence for a series of years, see "Merrimack River" in the chapter on "Examination of Rivers."

LAWRENCE.

Microscopical Examination of Water from the Merrimack River above Lawrence, opposite the Intake of the Lawrence Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	22	21	18	23	20	26	22	21	17	21	20
Number of sample,	13677	13862	14019	14168	14340	14496	14698	14888	15206	15384	15582	15771
PLANTS.												
Diatomaceæ,	**4**	**1**	**4**	**32**	**317**	**1,095**	**314**	**503**	**2**	**53**	**16**	**2**
Asterionella,	0	0	2	0	0	0	4	15	0	1	0	0
Cyclotella,	0	0	0	0	0	1	0	10	0	0	0	0
Diatoma,	0	0	0	4	2	0	0	0	2	0	0	0
Fragilaria,	0	0	0	0	0	4	1	68	0	2	0	0
Melosira,	0	0	0	0	0	0	13	2	0	10	0	0
Navicula,	0	0	1	4	0	8	6	3	0	1	1	0
Pinnularia,	0	0	0	0	0	10	2	2	0	3	1	0
Synedra,	4	1	1	22	312	1,000	272	392	0	36	2	2
Tabellaria,	0	0	0	2	3	72	16	11	0	0	12	0
Cyanophyceæ,	**0**	**0**	**0**	**2**	**0**	**21**	**5**	**0**	**2**	**3**	**0**	**0**
Microcystis,	0	0	0	0	0	21	5	0	0	0	0	0
Oscillaria,	0	0	0	2	0	0	0	0	2	3	0	0
Algæ,	**1**	**0**	**0**	**0**	**30**	**554**	**792**	**193**	**0**	**0**	**0**	**0**
Glœocapsa,	0	0	0	0	0	0	32	1	0	0	0	0
Protococcus,	1	0	0	0	17	540	364	188	0	0	0	0
Raphidium,	0	0	0	0	10	6	40	0	0	0	0	0
Scenedesmus,	0	0	0	0	3	8	24	4	0	0	0	0
Selenastrum,	0	0	0	0	0	0	332	0	0	0	0	0
Fungi, Crenothrix,	**7**	**44**	**6**	**12**	**68**	**17**	**40**	**4**	**104**	**28**	**24**	**0**
ANIMALS.												
Infusoria,	**2**	**0**	**10**	**0**	**9**	**0**	**12**	**4**	**0**	**1**	**0**	**0**
Dinobryon cases,	0	0	10	0	5	0	7	0	0	0	0	0
Euglena,	1	0	0	0	1	0	0	0	0	0	0	0
Paramæcium,	0	0	0	0	1	0	1	0	0	0	0	0
Peridinium,	0	0	0	0	0	0	4	3	0	0	0	0
Trachelomonas,	1	0	0	0	2	0	0	1	0	1	0	0
Vermes,	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**4**	**0**	**0**	**0**	**0**
Anurea,	0	0	0	0	0	3	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	0	0	0	4	0	0	0	0
Miscellaneous, Zoöglœa,	**128**	**120**	**88**	**0**	**536**	**0**	**0**	**216**	**0**	**200**	**100**	**20**
TOTAL,	142	165	108	46	960	1,690	1,163	924	108	285	140	22

LAWRENCE.

Chemical Examination of Water from the Force Main at the Pumping Station of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13678	Jan. 16	V. slight.	V. slight.	0.43	5.80	1.25	.0156	.0136	.0126	.0010	.36	.0150	.0000	.3571	2.5
13863	Feb. 20	None.	V. slight	0.60	7.60	1.40	.0278	.0098	.0084	.0014	.39	.0300	.0001	.2847	3.5
14020	Mar. 20	V. slight.	V. slight.	0.58	5.50	1.80	.0136	.0144	.0130	.0014	.26	.0070	.0001	.4558	2.5
14169	Apr. 17	V. slight.	Slight	0.70	6 95	1.90	.0328	.0084	.0072	.0012	.14	.0450	.0000	.3278	3.8
14341	May 21	V. slight.	V. slight.	0.48	5.40	1.50	.0090	.0098	.0086	.0012	.27	.0450	.0001	.4187	2.7
14497	June 19	Distinct.	Slight, rusty.	0.40	6.90	2.60	.0152	.0086	.0060	.0026	.34	.0350	.0003	.2418	2.9
14699	July 24	V. slight.	V. slight.	0.33	4.00	1.10	.0042	.0098	.0090	.0008	.36	.0170	.0000	.3465	2.1
14889	Aug 21	Distinct, milky.	Slight, rusty.	0.35	6.55	1.70	.0088	.0082	.0074	.0008	.37	.0420	.0000	.1950	3.0
15207	Sept. 18	Slight.	Slight, rusty.	0.23	5.20	1.30	.0050	.0086	.0074	.0012	.36	.0150	.0001	.2379	2.2
15385	Oct. 16	V. slight, milky.	Slight.	0.45	6.20	2.20	.0128	.0126	.0106	.0020	.41	.0300	.0000	.4095	3.0
15583	Nov. 20	V. slight.	V. slight.	1.00	6.55	1.80	.0226	.0118	.0106	.0012	.31	.0300	.0000	.5616	3.0
15772	Dec. 18	V. slight, clayey.	V. slight.	0.45	4.80	1.90	.0076	.0138	.0122	.0016	.20	.0180	.0000	.4735	1.4
Av.	1895	....	....	0.50	5.95	1.70	.0146	.0108	.0094	.0014	.31	.0274	.0001	.3592	2.7
Av.	1894	....	....	0.39	6.10	1.41	.0103	.0094	.0081	.0013	.30	.0309	.0002	.2910	2.8

NOTE to analyses of 1895: Odor, generally vegetable. —— The samples were collected from a faucet in the check-valve just beyond the pump, and represent water from the river which has passed through the sand filter, mingled with a small amount of ground water.

Microscopical Examination of Water from the Force Main at the Pumping Station of the Lawrence Water Works.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	22	21	18	23	20	26	22	21	17	21	20
Number of sample,	13678	13863	14020	14169	14341	14497	14699	14889	15207	15385	15583	15772
PLANTS.												
Fungi,	**154**	**66**	**136**	**86**	**268**	**520**	**44**	**396**	**63**	**0**	**1,080**	**0**
Crenothrix,	154	66	136	86	268	520	38	396	52	0	1,080	0
Molds,	0	0	0	0	0	0	6	0	11	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**56**	**0**	**0**	**16**	**0**	**2**	**0**	**0**
TOTAL,	154	66	136	86	324	520	44	412	63	2	1,080	0

LAWRENCE.

Chemical Examination of Water from the Distributing Reservoir of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13679	Jan. 16	V. slight.	None.	.38	5.50	1.50	.0096	.0144	.0126	.0018	.34	.0130	.0000	.3515	2.3
13864	Feb. 20	None.	V. slight.	.32	5.55	1.20	.0106	.0136	.0122	.0014	.31	.0200	.0000	.3526	2.2
14021	Mar. 20	V. slight.	V. slight.	.28	5.65	1.30	.0098	.0116	.0094	.0022	.29	.0220	.0000	.3634	2.3
14170	Apr. 17	V. slight.	V. slight.	.27	4.85	1.40	.0084	.0110	.0084	.0026	.26	.0250	.0001	.3792	2.3
14342	May 21	V. slight	Slight.	.30	4.85	1.80	.000[illegible]	.0100	.0086	.0014	.22	.0300	.0000	.3713	1.7
14498	June 19	Slight.	Slight.	.25	4.55	1.40	.0010	.0096	.0084	.0012	.28	.0220	.0002	.2769	1.7
14700	July 24	V. slight.	Slight.	.20	4.60	1.50	.0022	.0094	.0078	.0016	.36	.0200	.0001	.2849	2.5
14890	Aug. 21	V. slight.	V. slight	.13	5.00	1.95	.0024	.0092	.0082	.0010	.32	.0200	.0002	.2184	2.1
15208	Sept. 18	Slight.	Slight.	.18	4.85	1.30	.0018	.0090	.0068	.0022	.35	.0220	.0002	.2574	2.1
15386	Oct. 16	V. slight.	V. slight.	.15	4.80	1.65	.0018	.0072	.0058	.0014	.38	.0300	.0000	.2340	1.9
15584	Nov. 20	V. slight.	V. slight.	.50	4.90	1.70	.0068	.0156	.0138	.0018	.26	.0120	.0001	.5148	2.2
15773	Dec. 18	V. slight, clayey.	Slight.	.50	5.00	1.95	.0066	.0104	.0094	.0010	.18	.0280	.0001	.5043	1.8
Av.	....	....	....	.29	5.01	1.55	.0051	.0109	.0093	.0016	.30	.0220	.0001	.3424	2.1

Odor, generally vegetable, often none. —— Nos. 14700 and 14890 were collected from the reservoir; the other samples, from a faucet at the gate-house. The samples represent water flowing out of the reservoir. The reservoir is supplied with filtered water.

Microscopical Examination of Water from the Distributing Reservoir of the Lawrence Water Works.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	17	23	21	18	23	20	26	22	21	17	21	20
Number of sample, ...	13679	13864	14021	14170	14342	14498	14700	14890	15208	15386	15584	15773
PLANTS.												
Diatomaceæ, ...	**7**	**0**	**0**	**0**	**8**	**3**	**27**	**0**	**1,624**	**0**	**1**	**0**
Cyclotella, ...	0	0	0	0	1	0	0	0	1,560	0	0	0
Synedra, ...	7	0	0	0	7	3	27	0	64	0	1	0

LAWRENCE.

Microscopical Examination of Water from the Distributing Reservoir of the Lawrence Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.												
Algæ,	**0**	**0**	**0**	**0**	**25**	**26**	**101**	**0**	**76**	**0**	**0**	**0**
Protococcus,	0	0	0	0	25	25	100	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	1	0	32	0	0	0
Staurastrum,	0	0	0	0	0	1	0	0	44	0	0	0
Fungi, Crenothrix,	**16**	**24**	**2**	**600**	**52**	**28**	**7**	**16**	**7**	**2**	**20**	**0**
ANIMALS.												
Infusoria,	**0**	**pr.**	**2**	**4**	**0**	**0**	**1**	**1**	**10**	**0**	**0**	**0**
Dinobryon,	0	0	2	0	0	0	0	0	0	0	0	0
Dinobryon cases,	0	0	0	4	0	0	0	0	0	0	0	0
Peridinium,	0	pr.	0	0	0	0	1	1	10	0	0	0
Miscellaneous, Zoöglœa,	**1**	**0**	**230**	**0**	**0**	**0**	**0**	**54**	**18**	**0**	**0**	**0**
TOTAL,	24	24	234	604	85	57	136	71	1,735	2	21	0

Volume of Water flowing in the Merrimack River at Lawrence on the Dates when Samples of Water were collected for Analysis.

DATE.	Volume flowing in the Merrimack River in Cubic Feet per Second.		DATE.	Volume flowing in the Merrimack River in Cubic Feet per Second.	
	Rate of Flow during Eleven Hours of the Day.	Rate of Flow during the Whole Twenty-four Hours.		Rate of Flow during Eleven Hours of the Day.	Rate of Flow during the Whole Twenty-four Hours.
1895.			**1895** — Con.		
Jan. 16,	4,650	3,750	July 24,	3,500	2,600
Feb. 20,	2,820	1,800	Aug. 21,	3,140	2,150
March 20,	8,600	7,750	Sept. 18,	3,210	2,250
April 17,	70,550	70,550	Oct. 16,	14,380	13,500
May 21,	5,410	4,600	Nov. 20,	14,420	13,550
June 19,	3,400	2,490	Dec. 18,	6,400	5,580

WATER SUPPLY OF LEICESTER.

The advice of the State Board of Health to the town of Leicester, relative to taking an additional supply of water from Asnebumskit Pond in the town of Paxton, may be found on pages 32 and 33 of

LEICESTER.

this volume. The results of an analysis of a sample of water from this source, collected in August, 1893, may be found under *Paxton* in this volume.

Chemical Examination of Water from the Wells of the Leicester Water Supply District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13686	Jan. 17	None.	V. slight.	.47	6.20	.0000	.0126	.19	.0500	.0000	.6019	2.5	.0110
13951	Mar. 11	V. slight.	V. slight.	.68	6.95	.0006	.0154	.18	.0350	.0000	.7099	2.7	.0060
14272	May 10	V. slight.	V. slight	.53	5.40	.0008	.0118	.17	.0320	.0001	.5082	2.1	.0140
14631	July 16	None.	Slight.	.60	5.55	.0000	.0098	.20	.0470	.0000	.6552	2.1	-
15169	Sept. 16	None.	None.	.25	5.20	.0000	.0040	.27	.0600	.0003	.2691	1.9	-
15539	Nov. 11	None.	None.	.03	4.60	.0000	.0012	.23	.0500	.0000	.0546	1.8	.0040
Av.	....	....	....	.43	5.65	.0002	.0091	.21	.0457	.0001	.4665	2.2	.0087

Odor of No. 13951, faintly vegetable; of the other samples, none. On heating, vegetable odors were developed in the first and last samples.——The samples were collected from a faucet in the village.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 139.

Water Supply of Lenox.

During the year 1895 the capacity of the reservoir on the brook tributary to the Williams River was increased and a line of pipe constructed, by which water is delivered to the town by gravity, instead of being pumped to the distributing reservoir as was formerly done. The present capacity of the reservoir is estimated to be about 20,000,000 gallons, its area about 7 acres and its depth from 6 to 30 feet. The reservoir was prepared for the storage of water by removing the soil from the bottom and sides.

Water Supply of Leominster.

The advice of the State Board of Health to the town of Leominster with reference to taking Fall Brook in that town as an additional source of water supply may be found on pages 33–35 of this volume.

LEOMINSTER.

A small dam has been constructed on the stream flowing from Haynes Reservoir, at a point about 1,500 feet below the reservoir, and a pipe has been laid from this dam to Morse Reservoir, a distance of about 1,100 feet. By means of this dam and pipe line the water drawn from Haynes Reservoir can be diverted into Morse Reservoir, and during the drier portion of 1895, beginning with the first of July, the water drawn from Haynes Reservoir was diverted into Morse Reservoir and flowed to the distributing reservoir from the latter source. The deterioration in the quality of the water of Morse Reservoir in 1895, indicated by the table of averages by years given below, was due to the diversion into it of water from Haynes Reservoir.

Chemical Examination of Water from Morse Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13697	Jan. 22	Slight.	Slight.	0.33	3.00	1.25	.0256	.0258	.0224	.0034	.24	.0030	.0000	.4740	0.8
14015	Mar. 20	V. slight.	Cons.	0.18	2.05	0.55	.0010	.0090	.0078	.0012	.13	.0030	.0001	.2725	0.0
14352	May 22	V. slight.	Slight.	0.20	2.40	1.10	.0000	.0104	.0086	.0018	.15	.0000	.0000	.3458	0.3
14735	July 30	Distinct.	Cons.	0.28	2.45	1.25	.0002	.0344	.0204	.0140	.20	.0070	.0000	.4774	0.3
15243	Sept. 24	Distinct.	Cons., green.	0.37	3.65	2.20	.0064	.0424	.0362	.0062	.23	.0030	.0000	.4820	0.3
15619	Nov. 26	Slight.	Slight.	0.35	3.25	2.05	.0308	.0392	.0326	.0066	.16	.0080	.0001	.6240	0.3
Av.	....	....	....	0.28	2.80	1.40	.0107	.0269	.0213	.0055	.18	.0040	.0000	.4459	0.3

Averages by Years.

-	1887*	-	-	0.32	2.57	0.74	.0010	.0117	-	-	.12	.0028	-	-	-
-	1888†	-	-	0.13	1.98	0.58	.0001	.0065	-	-	.09	.0036	.0000	-	-
-	1893	-	-	0.40	2.73	1.36	.0009	.0175	.0135	.0040	.16	.0032	.0001	.5156	0.5
-	1894	-	-	0.36	2.59	1.11	.0026	.0169	.0128	.0041	.17	.0017	.0001	.4052	0.2
-	1895	-	-	0.28	2.80	1.40	.0107	.0269	.0213	.0055	.18	.0040	.0000	.4459	0.3

* June to December. † February to May.

NOTE to analyses of 1895: Odor, vegetable. — The samples were collected from the reservoir. The quality of the water of this reservoir was affected after the first of July by the diversion into it of water from Haynes reservoir.

LEOMINSTER.

Microscopical Examination of Water from Morse Reservoir, Leominster.

[Number of organisms per cubic centimeter.]

	1895.					
	Jan.	March.	May.	Aug.	Sept.	Nov.
Day of examination,	23	21	23	1	26	27
Number of sample,	13697	14015	14352	14735	15243	15619
PLANTS.						
Diatomaceæ,	**9**	**3**	**20**	**84**	**94**	**80**
Asterionella,	4	1	0	27	0	0
Fragilaria,	0	0	16	0	0	0
Melosira,	0	0	0	35	5	31
Navicula,	0	0	0	3	1	1
Synedra,	5	0	4	14	88	48
Tabellaria,	0	2	0	5	0	0
Cyanophyceæ,	**0**	**0**	**0**	**198**	**73**	**8**
Anabæna,	0	0	0	80	0	1
Clathrocystis,	0	0	0	42	73	7
Cœlosphærium,	0	0	0	76	0	0
Algæ,	**3,240**	**10**	**38**	**15**	**62**	**16**
Conferva,	0	0	0	12	0	0
Protococcus,	0	10	30	0	2	0
Raphidium,	0	0	0	0	7	0
Scenedesmus,	0	0	0	3	28	16
Selenastrum,	0	0	0	0	21	0
Staurogenia,	0	0	8	0	4	0
Tetraspora,	3,240	0	0	0	0	0
Fungi, Crenothrix,	**0**	**2**	**1**	**0**	**0**	**1**
ANIMALS.						
Infusoria,	**14**	**0**	**0**	**3**	**36**	**7**
Dinobryon cases,	4	0	0	0	36	0
Euglena,	5	0	0	0	0	0
Mallomonas,	0	0	0	1	0	0
Peridinium,	5	0	0	2	0	7
Vermes,	**0**	**0**	**0**	**0**	**5**	**0**
Anurea,	0	0	0	0	2	0
Rotatorian ova,	0	0	0	0	3	0
Crustacea, Entomostracan ova,	**1**	**0**	**0**	**0**	**0**	**0**
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**160**	**4**
TOTAL,	3,264	15	59	300	430	116

LEOMINSTER.

Chemical Examination of Water from Haynes Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13698	Jan. 22	Distinct.	Slight.	.20	2.60	0.95	.0336	.0202	.0152	.0050	.19	.0000	.0000	.2449	0.5
14016	Mar. 20	Slight.	Cons., green.	.38	2.90	1.20	.0520	.0228	.0172	.0056	.19	.0030	.0002	.3476	0.6
14353	May 22	Decided.	Heavy, floc. and sandy.	.20	2.25	1.40	.0002	.0386	.0172	.0214	.18	.0000	.0000	.3876	0.3
14734	July 30	Decided.	Cons.	.30	3.10	1.95	.0002	.0640	.0276	.0364	.20	.0050	.0000	.5390	0.3
15242	Sept. 24	Decided.	Cons., green.	.35	4.45	2.65	.0038	.1160	.0434	.0726	.18	.0060	.0000	.6006	0.3
15618	Nov. 26	Slight.	Slight.	.33	2.75	1.25	.0000	.0130	.0098	.0032	.15	.0000	.0000	.4836	0.3
Av.	....	....	....	.29	3.01	1.57	.0150	.0458	.0217	.0241	.18	.0023	.0000	.4339	0.4

Averages by Years.

-	1887*	-	-	.58	3.61	2.00	.0040	.0647	-	-	.13	.0084	-	-	-
-	1888	-	-	.36	2.80	1.42	.0023	.0352	-	-	.12	.0075	.0001	-	-
-	1889	-	-	.27	2.35	0.94	.0010	.0426	.0254	.0172	.11	.0034	.0001	-	-
-	1890	-	-	.21	2.86	1.66	.0003	.0500	.0210	.0290	.11	.0063	.0001	-	0.6
-	1891	-	-	.24	2.80	1.48	.0005	.0482	.0231	.0251	.10	.0097	.0001	-	0.2
-	1893	-	-	.32	2.98	1.72	.0050	.0462	.0244	.0218	.14	.0028	.0001	.5001	0.4
-	1894	-	-	.28	3.02	1.79	.0102	.0347	.0214	.0133	.15	.0020	.0001	.4628	0.3
-	1895	-	-	.29	3.01	1.57	.0150	.0458	.0217	.0241	.18	.0023	.0000	.4339	0.4

* June to December.

NOTE to analyses of 1895: Odor, in July, none; at other times, vegetable; in May, also disagreeable. On heating, the odor was frequently unpleasant. —— The samples were collected from the reservoir.

LEOMINSTER.

Microscopical Examination of Water from Haynes Reservoir, Leominster.

[Number of organisms per cubic centimeter.]

	1895.					
	Jan.	March.	May.	Aug.	Sept.	Nov.
Day of examination,	23	21	23	1	26	27
Number of sample,	13698	14016	14353	14734	15242	15618
PLANTS.						
Diatomaceæ,	0	25	3,150	350	750	4
Asterionella,	0	14	200	0	0	0
Melosira,	0	0	1,150	300	750	0
Navicula,	0	0	0	50	0	1
Synedra,	0	7	50	0	0	1
Tabellaria,	0	4	1,750	0	0	2
Cyanophyceæ,	2	0	150	2,450	9,600	0
Anabæna,	0	0	0	1,300	9,300	0
Chroöcoccus,	0	0	0	0	100	0
Clathrocystis,	1	0	150	1,000	200	0
Cœlosphærium,	1	0	0	50	0	0
Microcystis,	0	0	0	100	0	0
Algæ,	24	3	250	650	350	1
Closterium,	0	0	50	0	0	0
Pediastrum,	0	0	50	50	0	0
Protococcus,	0	0	0	450	0	0
Scenedesmus,	0	3	100	150	250	0
Staurastrum,	0	0	50	0	100	1
Tetraspora,	24	0	0	0	0	0
Fungi, Crenothrix,	0	184	100	0	0	0
ANIMALS.						
Infusoria,	31	9	0	50	0	0
Ciliated infusorian,	0	1	0	0	0	0
Dinobryon,	3	0	0	0	0	0
Dinobryon cases,	6	1	0	0	0	0
Euglena,	2	0	0	0	0	0
Mallomonas,	1	0	0	0	0	0
Peridinium,	19	7	0	50	0	0
Vermes, Polyarthra,	1	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	112	300	0	0	2
TOTAL,	58	333	3,950	3,500	10,700	7

LEOMINSTER.

Chemical Examination of Water from Fall Brook, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14490	June 18	Distinct.	Cons., yellow.	.30	3.25	1.25	.0070	.0210	.0142	.0068	.15	.0070	.0001	.3744	0.3
14491	June 18	Distinct.	Cons., fibrous.	.25	3.20	1.15	.0002	.0140	.0102	.0038	.13	.0070	.0000	.3237	0.2
14492	June 18	V. slight.	V. slight.	.25	4.75	1.80	.0004	.0086	.0072	.0014	.38	.0900	.0002	.2808	0.8

Odor, faintly vegetable. —— The first two samples were collected, respectively, from the South and North branches of Fall Brook where they cross May Street. The last sample was collected from Fall Brook at the falls, a short distance above the first road crossing below May Street.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14490, 382; No. 14491, 98; No. 14492, 8.

Water Supply of Lexington.

The works of the Lexington Water Company were purchased by the town Dec. 10, 1895.

Chemical Examination of Water from the Vine Brook Storage Reservoir of the Lexington Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
14391	May 30	Slight.	Cons.	.23	4.75	1.95	.0012	.0298	.0178	.0120	.54	.0500	.0012	.4294	1.7
14549	June 26	V. slight.	Slight.	.30	6.05	2.00	.0012	.0148	.0120	.0028	.51	.0470	.0001	.4027	2.5
14740	July 30	Distinct.	Cons.	.30	8.50	1.75	.0002	.0176	.0128	.0048	.54	.0420	.0002	.4158	4.4
15214	Sept. 19	Distinct.	Slight.	.40	5.80	2.00	.0022	.0308	.0260	.0048	.56	.0030	.0000	.5460	1.9
15448	Oct. 30	None.	V slight.	.80	8.95	3.10	.0024	.0218	.0184	.0034	.58	.0630	.0002	.9032	3.9
15501	Nov. 8	Slight.	Slight.	.50	6.35	2.15	.0004	.0302	.0248	.0054	.51	.0320	.0001	.6045	1.9
15632	Nov. 29	Slight	Slight.	.42	5.80	2.10	.0006	.0240	.0224	.0016	.43	.0300	.0001	.6146	2.1
15787	Dec. 23	V. slight.	V. slight.	.40	6.05	2.30	.0004	.0216	.0200	.0016	.43	.0500	.0002	.5683	1.9
Av*	....	....	....	.41	6.60	2.17	.0012	.0234	.0187	.0047	.52	.0409	.0003	.5536	2.6

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor of the first three samples, vegetable and disagreeable; of the other samples, vegetable or none, in some cases becoming mouldy on heating. —— No. 15448 was collected from a faucet at the pumping station while pumping; the other samples were collected from the reservoir.

LEXINGTON.

Microscopical Examination of Water from the Vine Brook Storage Reservoir of the Lexington Water Works.

[Number of organisms per cubic centimeter.]

	1895.							
	June.	June.	Aug.	Sept.	Nov.	Nov.	Dec.	Dec.
Day of examination,	1	28	2	21	1	12	2	24
Number of sample,	14391	14549	14740	15214	15448	15501	15632	15787
PLANTS.								
Diatomaceæ,	**36**	**308**	**0**	**0**	**0**	**0**	**0**	**0**
Synedra,	28	308	0	0	0	0	0	0
Tabellaria,	8	0	0	0	0	0	0	0
Cyanophyceæ, Clathrocystis,	**0**	**0**	**0**	**0**	**0**	**45**	**0**	**0**
Algæ,	**19**	**9**	**232**	**1,080**	**0**	**1,012**	**1,041**	**323**
Pediastrum,	0	0	0	0	0	1,012	0	0
Protococcus,	0	0	232	540	0	0	1,032	320
Raphidium,	1	6	0	540	0	0	9	3
Staurastrum,	18	3	0	0	0	0	0	0
Fungi, Crenothrix,	**0**	**32**	**24**	**0**	**1**	**0**	**1**	**0**
ANIMALS.								
Infusoria,	**136**	**257**	**0**	**0**	**0**	**0**	**0**	**0**
Dinobryon,	0	256	0	0	0	0	0	0
Dinobryon cases,	136	0	0	0	0	0	0	0
Peridinium,	pr.	1	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**60**	**0**	**0**
TOTAL,	191	606	256	1,080	1	1,117	1,042	323

WATER SUPPLY OF LINCOLN.

(See *Concord.*)

WATER SUPPLY OF LONGMEADOW.

Population in 1895, 620. The works were built by the town, and water was first introduced Feb. 1, 1895. The source of supply is a small brook near the center of the town, from which the water is diverted into a covered collecting well. From this well the water is forced by pumps into an open iron tank 22 feet in diameter and 30 feet high. The brook has a watershed at the point of diversion of about one-half of a square mile, and has a very small population on its watershed.

The collecting well is 30 feet square and $8\frac{1}{2}$ feet deep, built of masonry and covered with a wooden roof. Distributing mains are of cast iron and service pipes of galvanized iron. At the end of the year 1895 there were about 68 connections with the mains.

Water Supply of Lowell.

During the year 1895 a second system of tubular wells for supplying water to the city of Lowell was constructed in the valley of River Meadow Brook just above the point where it is crossed by the Old Middlesex Canal in the town of Chelmsford, the wells being distant about a mile up the valley in a straight line from the nearest of the system of tubular wells constructed in 1892.

The new system consists of about 120 2-inch wells, averaging about 45 feet in depth. Two-thirds of the wells are located in two lines 12 feet apart, parallel to the Old Middlesex Canal and about 200 feet south-west of it. The wells are 25 feet apart in the lines. The remaining wells are located in two similar parallel lines about 12 feet apart, extending from the centre of the other lines, and approximately at right angles to them. The wells in these lines are also 25 feet apart, excepting that there is a break of about 300 feet near the middle where there are no wells, the material at that point being found to consist of peaty soil to a depth ranging from 6 to 35 feet. Pumping from this system of wells into the city mains was begun April 5, 1895.

Eighteen wells have been added to the original system of wells lower down the valley.

During the year 1895 about 66 per cent. of the water supplied to the city was drawn from the systems of tubular wells in the valley of River Meadow Brook, the remainder being drawn from the Merrimack River.

The results of analyses of samples of water from the Merrimack River and from the two systems of tubular wells in the valley of River Meadow Brook are given in the following tables.

These results show that the water of the original system of tubular wells in the valley of River Meadow Brook just above Plain Street has been somewhat harder than last year and has contained a considerably greater amount of residue on evaporation.

Analyses of samples from the new system of tubular wells in the valley of River Meadow Brook have been made once in two weeks and sometimes more frequently since pumping from these wells into the city mains was begun in April. The results of these investigations show that there has been a very great increase in the color, residue on evaporation, ammonia, hardness and iron during the year, the maximum being reached in November. The iron oxidizes on

LOWELL.

exposure to the air, giving the water at first a milky turbidity, and subsequently precipitating in the form of a rusty sediment.

Chemical Examination of Water from the Merrimack River above Lowell, opposite the Intake of the Lowell Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13660	Jan. 15	Slight, milky.	Slight.	.30	4.25	1.25	.0076	.0174	.0148	.0026	.29	.0040	.0000	.4345	1.6
13843	Feb. 19	Distinct.	Slight.	.28	4.35	1.35	.0084	.0158	.0140	.0018	.25	.0050	.0000	.4329	1.4
13999	Mar. 19	Slight.	Cons., brown.	.48	3.40	1.15	.0026	.0166	.0134	.0032	.17	.0070	.0001	.5925	0.8
14153	Apr. 16	Decided, clayey.	Cons., earthy.	.53	3.40	1.35	.0068	.0296	.0134	.0162	.13	.0100	.0001	.6636	1.5
14335	May 21	Slight.	Cons.	.38	3.25	1.35	.0014	.0128	.0088	.0040	.17	.0080	.0001	.5016	1.3
14481	June 18	Distinct.	Slight.	.27	3.65	1.55	.0008	.0196	.0124	.0072	.20	.0050	.0002	.3838	0.8
14870	Aug. 20	Distinct.	Slight.	.33	4.45	2.10	.0028	.0150	.0118	.0032	.22	.0050	.0001	.3588	0.9
15183	Sept. 17	Slight.	Slight.	.22	3.55	1.05	.0056	.0170	.0154	.0016	.26	.0030	.0001	.3471	1.6
15369	Oct. 15	Distinct.	Cons.	.60	4.55	1.80	.0000	.0258	.0198	.0060	.31	.0070	.0001	.8034	1.6
15570	Nov. 20	Slight.	Slight.	.72	3.65	1.55	.0004	.0212	.0162	.0050	.19	.0070	.0000	.8408	1.1
15752	Dec. 17	Slight.	Slight.	.40	3.75	1.60	.0060	.0156	.0144	.0012	.14	.0120	.0001	.5298	1.1
Av.	....	....	....	.41	3.84	1.46	.0039	.0187	.0140	.0047	.21	.0066	.0001	.5353	1.2

Averages by Years.

-	1887*	-	-	.44	4.29	1.16	.0021	.0158	-	-	.17	.0084	-	-	-
-	1888	-	-	.30	3.42	0.97	.0016	.0160	.0133	.0027	.16	.0099	.0002	-	-
-	1889	-	-	.28	2.05†	0.84†	.0018	.0149	.0126	.0023	.14	.0071	.0002	-	-
-	1890	-	-	.30	3.57‡	1.54‡	.0014	.0128	.0104	.0024	.13	.0111	.0001	-	1.4
-	1891	-	-	.29	3.43	1.23	.0017	.0129	.0100	.0029	.13	.0137	.0001	-	1.2
-	1892	-	-	.39	3.61	1.36	.0021	.0141	.0113	.0028	.14	.0092	.0001	-	1.3
-	1893	-	-	.33	3.39	1.18	.0026	.0149	.0120	.0029	.17	.0083	.0001	.4437	1.1
-	1894	-	-	.35	3.55	1.26	.0034	.0135	.0109	.0026	.18	.0063	.0001	.3990	1.1
-	1895	-	-	.41	3.84	1.46	.0039	.0187	.0140	.0047	.21	.0066	.0001	.5353	1.2

* June to December. † January to May. ‡ September to December.

NOTE to analyses of 1895: Odor, generally vegetable and musty or mouldy, sometimes unpleasant or disagreeable. —— The samples were collected from the river, about 1 foot beneath the surface.

For a comparison of the analyses of the river at Lowell and Lawrence for a series of years, see "Merrimack River" in the chapter on "Examination of Rivers" in a subsequent portion of this report.

LOWELL.

Chemical Examination of Water from Tubular Wells in the Valley of River Meadow Brook, a Short Distance above Plain Street.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13661	Jan. 15	V. slight.	V. slight.	.04	8.90	.0000	.0034	.58	.0280	.0001	.0276	3.9	.0125
13844	Feb. 19	None.	None.	.03	8.80	.0002	.0022	.60	.0320	.0001	.0328	3.8	.0115
14000	Mar. 19	V. slight.	Slight, dark.	.02	9.00	.0002	.0018	.60	.0370	.0001	.0434	4.2	.0300
14154	Apr. 16	V. slight.	None.	.02	8.50	.0000	.0014	.50	.0200	.0000	.0671	3.4	.0120
14337	May 21	None.	None.	.04	8.90	.0002	.0006	.54	.0330	.0000	.0434	3.8	.0140
14482	June 18	None.	None.	.02	8.20	.0000	.0028	.47	.0150	.0000	.0328	3.5	.0100
14656	July 22	None.	None.	.03	9.90	.0000	.0030	.49	.0250	.0001	.0600	3.8	.0120
14872	Aug. 20	None.	None.	.02	9.40	.0000	.0032	.52	.0220	.0001	.0468	3.6	.0120
15185	Sept. 17	None.	None.	.02	10.00	.0002	.0014	.59	.0280	.0001	.0546	3.8	.0090
15372	Oct. 15	None.	V. slight.	.01	10.20	.0000	.0014	.72	.0500	.0002	.0507	4.2	.0040
15591	Nov. 21	None.	None.	.01	9.50	.0000	.0036	.56	.0450	.0011	.0858	3.9	.0100
15753	Dec. 17	None.	V. slight.	.02	9.40	.0000	.0042	.51	.0530	.0002	.0962	3.6	.0060
Av..	1895	....	....	.02	9.22	.0001	.0024	.56	.0323	.0002	.0534	3.8	.0119
Av..	1894	....	....	.02	7.33	.0003	.0014	.55	.0549	.0002	.0232	2.8	.0078

NOTE to analyses of 1895: Odor, in September, November and December, distinct; at other times, none.——The samples were collected from a faucet at the pumping station while pumping. The wells are locally known as the "Cook" wells.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 31, consisting chiefly of *Crenothrix*.

LOWELL.

Chemical Examination of Water from Tubular Wells in the Valley of River Meadow Brook, a Short Distance above the Old Middlesex Canal in Chelmsford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
13718	Jan. 24	None.	None.	.00	4.40	.0000	.0000	.18	.0130	.0000	.0000	1.6	.0000
13905	Mar. 4	Distinct, floc.	Slight, white.	.25	6.60	.0000	.0002	.31	.0000	.0000	.0308	2.6	.0920
14028	Mar. 20	Slight.	Slight.	.25	6.80	.0006	.0004	.29	.0000	.0000	.0632	2.5	.0740
14095	Apr. 3	None.	None.	.00	5.90	.0004	.0000	.27	.0090	.0000	.0192	2.3	.0070
14101	Apr. 6	None.	None.	.03	6.00	.0010	.0020	.31	.0050	.0001	.0370	2.3	.0200
14138	Apr. 12	V.slight.	None.	.04	6.30	.0004	.0008	.31	.0000	.0000	.0231	2.3	.0300
14209	Apr. 24	None.	V.slight.	.07	5.80	.0010	.0018	.30	.0050	.0000	.0355	2.2	.0330
14217	Apr. 30	Slight.	Slight.	.08	6.50	.0012	.0014	.32	.0080	.0000	.0231	2.6	.0020
14252	May 7	V.slight.	V.slight.	.02	6.50	.0006	.0006	.28	.0030	.0000	.0131	2.7	.0400
14294	May 14	Distinct.	V.slight.	.10	7.50	.0018	.0008	.28	.0060	.0000	.0158	2.6	.0600
14336	May 21	Slight.	Slight.	.10	6.60	.0006	.0004	.32	.0070	.0000	.0237	2.7	.0580
14379	May 28	Slight.	Slight.	.12	7.70	.0006	.0010	.30	.0050	.0000	.0494	2.7	.0300
14427	June 5	V.slight.	V.slight.	.12	7.50	.0018	.0036	.33	.0050	.0000	.0304	2.6	.0660
14483	June 18	V.slight.	V.slight.	.20	7.60	.0014	.0012	.30	.0070	.0000	.0218	2.9	.0690
14601	July 10	None.	V.slight.	.04	7.40	.0012	.0012	.33	.0070	.0000	.0553	3.0	.0370
14657	July 22	Slight.	Slight.	.13	7.80	.0008	.0016	.33	.0070	.0001	.0600	3.5	.0350
14786	Aug. 7	None.	Slight.	.10	7.30	.0020	.0010	.33	.0100	.0000	.0312	3.5	.0420
14871	Aug. 20	V.slight.	V.slight.	.07	7.00	.0014	.0012	.35	.0050	.0001	.0624	2.9	.0430
14965	Sept. 4	None.	None.	.10	7.50	.0080	.0010	.36	.0000	.0000	.0462	2.7	.0360
15184	Sept. 17	None.	None.	.10	7.20	.0010	.0016	.34	.0070	.0000	.0374	2.7	.0310
15303	Oct. 2	None.	None.	.08	7.20	.0010	.0020	.35	.0070	.0000	.0702	2.6	.0260
15373	Oct. 15	V slight.	V.slight.	.03	11.00	.0026	.0020	.35	.0180	.0001	.0842	4.6	.0470
15479	Nov. 5	None.	V.slight.	.40	20.50	.0060	.0030	.33	.0220	.0003	.0975	8.7	.2000
15559	Nov. 18	Distinct.	Slight, rusty.	.40	25.10	.0080	.0042	.35	.0120	.0000	.1638	10.3	.3400
15571	Nov. 19	Slight, milky.	Slight.	.20	23.90	.0064	.0060	.29	.0150	.0001	.1654	10.6	.3250
15668	Dec. 3	None.	V.slight.	.18	20.10	.0040	.0054	.33	.0100	.0001	.1326	9.7	.0750
15754	Dec. 17	V.slight.	V.slight.	.12	20.10	.0054	.0046	.31	.0130	.0000	.0731	9.7	.0690

Odor of the last four samples, vegetable; of the other samples, none.——The samples were collected from a faucet at the pumping station while pumping. The wells are locally known as the "Hydraulic Company's" wells.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 28, consisting chiefly of *Crenothrix*.

Water Supply of Ludlow.

(See *Springfield.*)

Water Supply of Lynn and Saugus.

Chemical Examination of Water from Breed's Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13629	Jan. 8	V. slight.	Slight.	.62	3.90	1.25	.0030	.0176	.0162	.0014	.65	.0040	.0000	.4797	0.9
13807	Feb. 12	V. slight.	V. slight.	.50	4.00	1.10	.0016	.0152	.0122	.0030	.78	.0050	.0000	.5000	1.3
13969	Mar. 12	Slight.	Cons.	.25	3.15	1.25	.0008	.0166	.0094	.0072	.54	.0050	.0001	.3580	0.6
14117	Apr. 9	Slight.	Cons.	.53	3.70	1.55	.0010	.0124	.0102	.0022	.56	.0050	.0000	.5197	0.9
14283	May 13	Slight.	Slight.	.52	3.80	1.30	.0002	.0216	.0172	.0044	.52	.0020	.0000	.5372	1.1
14455	June 11	Slight.	Cons.	.40	3.80	2.10	.0010	.0174	.0158	.0016	.52	.0050	.0001	.4820	0.8
14633	July 16	Slight.	Cons.	.50	3.25	1.55	.0000	.0214	.0188	.0026	.58	.0070	.0001	.4914	0.7
14828	Aug. 12	Distinct.	Cons.	.33	3.70	1.40	.0012	.0212	.0188	.0024	.59	.0030	.0001	.5148	0.9
15130	Sept. 9	Distinct.	Slight.	.33	4.10	1.50	.0000	.0220	.0198	.0022	.61	.0000	.0001	.4914	0.9
15339	Oct. 9	V. slight.	Slight.	.37	3.55	1.30	.0004	.0256	.0226	.0030	.66	.0000	.0000	.4290	0.9
15525	Nov. 12	V. slight.	V. slight.	.57	4.00	1.85	.0044	.0292	.0270	.0022	.52	.0050	.0000	.5788	1.3
15710	Dec. 9	V. slight.	Slight.	.90	4.00	1.65	.0054	.0186	.0172	.0014	.46	.0020	.0001	.6568	0.8
Av.	....	....	....	.48	3.75	1.48	.0016	.0199	.0171	.0028	.58	.0036	.0001	.5032	0.9

Averages by Years.

-	1887*	-	-	.51	3.70	1.32	.0006	.0217	-	-	.44	.0024	-	-	-
-	1888	-	-	.48	3.71	1.42	.0029	.0227	-	-	.45	.0053	.0001	-	-
-	1889	-	-	.45	3.09	1.02	.0007	.0208	.0165	.0043	.41	.0035	.0001	-	-
-	1890	-	-	.42	3.62	1.51	.0014	.0196	.0155	.0041	.41	.0052	.0001	-	1.1
-	1891	-	-	.35	3.35	1.37	.0009	.0156	.0131	.0025	.40	.0080	.0001	-	0.8
-	1892	-	-	.43	3.65	1.38	.0004	.0220	.0177	.0043	.49	.0055	.0000	-	1.0
-	1893	-	-	.65	3.61	1.41	.0039	.0214	.0181	.0033	.55	.0054	.0001	.5102	1.1
-	1894	-	-	.65	3.77	1.47	.0023	.0225	.0191	.0034	.58	.0032	.0000	.5264	0.9
-	1895	-	-	.48	3.75	1.48	.0016	.0199	.0171	.0028	.58	.0036	.0001	.5032	0.9

* June to December.

NOTE to analyses of 1895: Odor, generally vegetable, becoming stronger and sometimes unpleasant on heating. —— The samples were collected from the pond near the gate-house, about 1 foot beneath the surface.

LYNN AND SAUGUS.

Microscopical Examination of Water from Breed's Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	14	14	10	14	12	17	14	12	10	13	12
Number of sample,	13629	13807	13969	14117	14283	14455	14633	14828	15130	15339	15525	15710
PLANTS.												
Diatomaceæ,	0	0	0	9	77	290	508	614	336	22	33	3
Asterionella,	0	0	0	0	24	55	184	192	288	13	32	1
Melosira,	0	0	0	0	0	1	7	0	0	0	0	0
Synedra,	0	0	0	1	10	2	1	2	0	0	1	2
Tabellaria,	0	0	0	8	43	232	316	420	48	9	0	0
Cyanophyceæ,	0	0	0	0	32	0	4	0	0	0	10	0
Anabæna,	0	0	0	0	32	0	4	0	0	0	0	0
Nostoc,	0	0	0	0	0	0	0	0	0	0	10	0
Algæ,	0	0	0	1	15	22	303	0	16	26	0	4
Conferva,	0	0	0	0	0	0	6	0	0	0	0	0
Pediastrum,	0	0	0	0	0	0	0	0	0	10	0	0
Protococcus,	0	0	0	1	6	18	272	0	0	0	0	0
Raphidium,	0	0	0	0	9	4	25	0	8	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	8	16	0	4
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	1	0	0	0	0	0	0	2
Infusoria,	5	12	1	6	126	0	371	493	45	8	24	2
Ciliated infusorian,	0	0	0	0	0	0	120	0	0	1	0	0
Dinobryon,	0	0	0	0	0	0	244	448	40	0	22	0
Dinobryon cases,	0	6	0	3	120	0	0	0	0	0	0	0
Mallomonas,	1	0	1	0	5	0	1	0	0	4	0	2
Peridinium,	4	4	0	3	1	0	4	44	2	1	1	0
Trachelomonas,	pr.	2	0	0	0	0	2	1	3	2	1	0
Vermes,	0	0	0	0	6	0	0	1	0	0	0	0
Anuræa,	0	0	0	0	4	0	0	1	0	0	0	0
Rotifer,	0	0	0	0	2	0	0	0	0	0	0	0
Miscellaneous,	0	0	0	56	0	0	0	.06	48	24	0	0
Acarina,	0	0	0	0	0	0	0	.06	.06	0	0	0
Zoöglœa,	0	0	0	56	0	0	0	0	48	24	0	0
TOTAL,	5	12	1	72	257	312	1,186	1,108	445	80	67	11

LYNN AND SAUGUS.

Chemical Examination of Water from Birch Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13628	Jan. 8	Decided.	Slight.	.90	7.00	3.30	.0018	.0426	.0264	.0162	.86	.0100	.0002	.7621	1.9
13806	Feb. 12	V. slight.	Slight.	.60	5.65	2.05	.0086	.0376	.0228	.0148	.78	.0100	.0000	.7216	1.8
14078	Apr. 1	Distinct.	Slight.	.55	5.85	1.65	.0086	.0296	.0222	.0074	.69	.0090	.0000	.5328	1.6
14116	Apr. 9	V. slight.	Slight.	.55	5.15	1.75	.0038	.0228	.0158	.0070	.71	.0080	.0001	.6083	1.7
14282	May 13	Slight.	Cons.	.47	4.75	1.60	.0004	.0266	.0210	.0056	.66	.0030	.0000	.6336	1.7
14454	June 11	Slight.	Cons., brown.	.32	4.25	1.75	.0006	.0220	.0172	.0048	.66	.0000	.0001	.4742	1.1
14632	July 16	Slight.	Cons.	.50	4.65	2.30	.0004	.0264	.0186	.0078	.66	.0030	.0000	.6708	1.3
14827	Aug 12	Distinct.	Cons., brown.	.35	4.40	1.95	.0020	.0294	.0230	.0064	.68	.0050	.0001	.5304	1.3
15131	Sept. 9	Distinct.	Slight.	.48	4.60	1.95	.0046	.0256	.0226	.0030	.71	.0000	.0001	.5538	1.4
15338	Oct. 9	V. slight.	Slight.	.68	4.15	1.95	.0040	.0364	.0308	.0056	.75	.0030	.0000	.5538	0.9
15524	Nov. 12	Distinct.	Slight.	.90	5.80	2.35	.0026	.0330	.0268	.0062	.67	.0170	.0001	.5132	1.4
15709	Dec. 9	V. slight.	Slight.	.90	4.80	2.45	.0030	.0178	.0162	.0016	.52	.0100	.0001	.8073	1.3
Av.	....	....	....	.60	5.05	2.12	.0031	.0294	.0222	.0072	.70	.0063	.0001	.6174	1.4

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1887*	-	-	.57	4.02	1.61	.0016	.0289	-	-	.43	.0044	-	-	-
-	1888	-	-	.33	3.48	1.40	.0026	.0287	-	-	.45	.0082	.0001	-	-
-	1889	-	-	.23	2.96	1.14	.0014	.0236	.0190	.0046	.41	.0048	.0001	-	-
-	1890	-	-	.36	3.57	1.35	.0013	.0227	.0179	.0048	.42	.0088	.0001	-	1.0
-	1891	-	-	.42	3.26	1.30	.0005	.0241	.0183	.0058	.40	.0065	.0001	-	0.7
-	1892	-	-	.48	3.73	1.56	.0016	.0299	.0227	.0072	.47	.0092	.0001	-	1.0
-	1893	-	-	.75	4.21	1.63	.0052	.0299	.0218	.0081	.51	.0059	.0001	.5285	1.0
-	1894	-	-	.75	4.47	1.88	.0053	.0292	.0242	.0050	.57	.0076	.0001	.6299	1.1
-	1895	-	-	.60	5.05	2.12	.0031	.0294	.0222	.0072	.70	.0063	.0001	.6174	1.4

* June to December.

NOTE to analyses of 1895: Odor, generally vegetable, sometimes also unpleasant, rarely none. —— The samples were collected from the pond near the gate-house, 1 foot beneath the surface. A portion of the water entering this pond during the year was pumped from the Saugus River.

Regarding the quality of the water of this river see reports for 1894 and 1893.

LYNN AND SAUGUS.

Microscopical Examination of Water from Birch Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Apr.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	14	3	10	14	12	17	14	12	10	13	12
Number of sample,	13628	13806	14078	14116	14282	14454	14632	14827	15131	15338	15524	15709
PLANTS.												
Diatomaceæ,	**4**	**0**	**3**	**0**	**664**	**59**	**1,449**	**1,886**	**466**	**239**	**7**	**21**
Asterionella,	0	0	0	0	644	0	480	196	420	11	0	0
Cyclotella,	1	0	0	0	1	23	920	252	0	0	0	2
Fragilaria,	0	0	0	0	0	6	0	30	0	0	0	0
Melosira,	0	0	0	0	0	0	6	8	12	80	0	0
Synedra,	3	0	3	0	7	25	3	0	8	88	7	15
Tabellaria,	0	0	0	0	12	5	40	1,400	26	60	0	4
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**17**	**1**	**0**	**0**	**0**
Anabæna,	0	0	0	0	0	67	0	0	0	0	0	0
Microcystis,	0	0	0	0	0	0	0	17	1	0	0	0
Algæ,	**9**	**0**	**10**	**3**	**389**	**486**	**39**	**83**	**27**	**48**	**1**	**11**
Arthrodesmus,	0	0	0	0	0	1	10	0	2	0	0	0
Chlorococcus,	0	0	0	0	20	8	0	0	0	3	0	0
Protococcus,	4	0	4	0	352	452	11	51	0	1	0	4
Raphidium,	0	0	0	0	16	0	0	6	12	19	0	5
Scenedesmus,	0	0	0	0	0	5	0	2	0	1	0	2
Selenastrum,	0	0	0	0	0	0	0	0	0	20	0	0
Staurastrum,	0	0	0	0	1	20	18	20	13	1	0	0
Staurogenia,	0	0	0	0	0	0	0	4	0	3	0	0
Zoöspores,	5	0	6	3	0	0	0	0	0	0	1	0
Fungi, Crenothrix,	**0**	**0**	**7**	**1**	**0**	**33**	**0**	**0**	**1**	**1**	**0**	**1**
ANIMALS.												
Rhizopoda, Actinophrys,	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**66**	**277**	**152**	**163**	**42**	**6**	**171**	**130**	**39**	**10**	**20**	**6**
Dinobryon,	0	0	31	80	1	0	0	0	0	4	0	3
Dinobryon cases,	4	44	100	68	36	0	116	22	5	0	0	0
Euglena,	2	124	1	2	0	0	0	0	0	0	0	0
Mallomonas,	0	0	1	3	1	0	0	8	0	0	0	0
Peridinium,	54	108	19	9	4	6	3	0	0	3	20	3
Synura,	6	0	0	0	0	0	0	0	0	0	0	0
Tintinnidium,	0	0	0	0	0	0	0	0	2	0	0	0
Trachelomonas,	0	1	0	1	0	0	50	100	32	3	0	0
Vorticella,	0	0	0	0	0	0	2	0	0	0	0	0
Vermes,	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**1**	**2**	**0**	**0**
Anurea,	0	0	0	0	4	0	0	0	0	1	0	0
Rotatorian ova,	0	0	0	0	0	0	0	0	1	1	0	0
Crustacea, Daphnia,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.08**	**0**	**0**
Miscellaneous,	**0**	**0**	**0**	**0**	**54**	**0**	**.20**	**.06**	**112**	**0**	**80**	**5**
Acarina,	0	0	0	0	0	0	.20	.06	.04	0	0	0
Zoöglœa,	0	0	0	0	54	0	0	0	112	0	80	5
TOTAL,	79	277	174	167	1,153	651	1,659	2,116	647	300	108	44

LYNN AND SAUGUS.

Chemical Examination of Water from Walden Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14285	May 13	V. slight.	Cons.	0.73	3.90	1.70	.0044	.0264	.0242	.0022	.46	.0030	.0000	.7386	1.1
14457	June 11	Slight.	Cons., brown.	0.70	3.65	2.10	.0002	.0304	.0224	.0080	.56	.0030	.0001	.6318	0.6
14635	July 16	Slight.	Cons.	1.30	4.40	2.25	.0328	.0536	.0320	.0216	.50	.0070	.0003	.8580	0.5
Av.	....	....	....	0.91	3.98	2.02	.0125	.0368	.0262	.0106	.51	.0043	.0001	.7428	0.7

Averages by Years.

-	1890	-	-	1.06	4.98	2.53	.0292	.0432	.0351	.0081	.34	.0057	.0001	-	1.1
-	1891	-	-	1.21	4.32	2.20	.0058	.0615	.0403	.0212	.34	.0091	.0001	-	0.7
-	1892	-	-	0.90	4.81	2.50	.0094	.0626	.0383	.0243	.41	.0116	.0001	-	0.6
-	1893	-	-	0.92	4.33	2.40	.0066	.0470	.0309	.0161	.44	.0047	.0001	.7954	0.7
-	1894*	-	-	0.94	3.95	2.06	.0056	.0346	.0240	.0106	.47	.0015	.0000	.7884	0.5
-	1895†	-	-	0.91	8.98	2.02	.0125	.0368	.0262	.0106	.51	.0043	.0001	.7428	0.7

* January to June. † May, June and July.

NOTE to analyses of 1895: Odor, vegetable and unpleasant.——The samples were collected from the pond near the gate-house, 1 foot beneath the surface.

Microscopical Examination of Water from Walden Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1895. May.	1895. June.	1895. July.
Day of examination,	14	13	17
Number of sample,	14285	14457	14635
PLANTS.			
Diatomaceæ,	**172**	**0**	**0**
Asterionella,	156	0	0
Tabellaria,	16	0	0
Cyanophyceæ,	**0**	**0**	**108**
Anabæna,	0	0	17
Clathrocystis,	0	0	91
Algæ,	**45**	**78,241**	**0**
Botrycoccus,	2	0	0
Chlorococcus,	16	0	0
Protococcus,	17	78,240	0
Raphidium,	3	0	0
Scenedesmus,	5	0	0
Staurastrum,	2	1	0
Fungi, Crenothrix,	**2**	**0**	**0**

LYNN AND SAUGUS.

Microscopical Examination of Water from Walden Pond, Lynn — Concluded.

[Number of organisms per cubic centimeter.]

	1895.		
	May.	June.	July.
ANIMALS.			
Infusoria,	**10**	**0**	**15**
Dinobryon cases,	7	0	0
Synura,	1	0	0
Trachelomonas,	1	0	15
Vorticella,	1	0	0
Vermes,	**9**	**0**	**0**
Monocerca,	1	0	0
Polyarthra,	2	0	0
Rotifer,	6	0	0
Crustacea, Cyclops,	**.03**	**0**	**.14**
TOTAL,	238	78,241	123

Chemical Examination of Water from Glen Lewis Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13630	Jan. 8	Decided.	Slight.	.73	4.55	2.00	.0034	.0354	.0242	.0112	.58	.0000	.0000	.8346	0.8
13808	Feb. 12	V. slight.	V. slight.	.55	3.90	1.50	.0102	.0240	.0228	.0012	.59	.0030	.0000	.5960	0.8
13970	Mar. 12	Slight.	Cons.	.25	3.15	1.35	.0144	.0146	.0136	.0010	.43	.0050	.0000	.3349	1.9
14118	Apr. 9	Slight.	Cons.	.50	3.55	1.30	.0036	.0314	.0206	.0108	.45	.0040	.0000	.4620	0.3
14284	May 13	Slight.	Cons.	.45	3.55	1.55	.0000	.0306	.0226	.0080	.48	.0030	.0000	.5253	0.8
14456	June 11	Slight.	Cons., brown.	.40	3.20	1.45	.0012	.0230	.0184	.0046	.50	.0050	.0001	.3978	0.3
14634	July 16	Distinct	Cons.	.53	4.30	1.65	.0004	.0284	.0226	.0058	.50	.0050	.0001	.4914	0.5
14829	Aug. 12	Decided, green.	Cons., green and brown.	.42	3.25	1.35	.0052	.0796	.0318	.0478	.48	.0030	.0002	.5694	0.5
15132	Sept. 9	Decided, green.	Heavy, green.	.28	3.60	1.65	.0028	.0706	.0272	.0434	.55	.0000	.0001	.6045	0.9
15340	Oct. 9	Distinct.	Cons., green.	.25	4.15	2.20	.0016	.0550	.0366	.0184	.56	.0030	.0000	.5366	0.8
15526	Nov. 12	Slight, green.	Slight.	.30	3.90	2.00	.0098	.0372	.0336	.0036	.48	.0080	.0001	.5600	0.6
15711	Dec. 9	Distinct, green.	V. slight.	.37	4.15	1.85	.0106	.0276	.0218	.0058	.42	.0030	.0002	.5772	0.5
Av.	....	....	....	.42	3.77	1.65	.0053	.0381	.0246	.0135	.50	.0035	.0001	.5408	0.7

Averages by Years.

-	1890	-	-	.76	4.84	2.21	.0412	.0445	.0327	.0118	.36	.0063	.0001	-	1.0
-	1891	-	-	.63	3.90	1.75	.0328	.0484	.0324	.0160	.34	.0124	.0002	-	0.6
-	1892	-	-	.62	3.95	1.95	.0127	.0475	.0332	.0143	.40	.0193	.0002	-	0.6
-	1893	-	-	.64	3.81	2.14	.0112	.0729	.0329	.0400	.42	.0040	.0002	.6048	0.6
-	1894	-	-	.85	3.81	1.89	.0107	.0495	.0297	.0198	.44	.0023	.0001	.6869	0.5
-	1895	-	-	.42	3.77	1.65	.0053	.0381	.0246	.0135	.50	.0035	.0001	.5408	0.7

NOTE to analyses of 1895: Odor, generally distinctly vegetable and frequently also mouldy, unpleasant or disagreeable.——The samples were collected from the pond near the gate-house, 1 foot beneath the surface.

LYNN AND SAUGUS.

Microscopical Examination of Water from Glen Lewis Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	14	14	10	14	12	17	15	12	10	14	12
Number of sample,	13630	13808	13970	14118	14284	14456	14634	14829	15132	15340	15526	15711
PLANTS.												
Diatomaceæ,	0	0	0	3	612	1	6	0	50	150	15	21
Asterionella,	0	0	0	0	260	0	1	0	0	0	0	0
Fragilaria,	0	0	0	0	0	0	0	0	0	0	0	10
Melosira,	0	0	0	2	340	0	5	0	0	150	12	0
Synedra,	0	0	0	0	0	1	0	0	50	0	3	3
Tabellaria,	0	0	0	1	12	0	0	0	0	0	0	8
Cyanophyceæ,	4	0	3	0	47	5	164	4,150	2,000	450	24	9
Anabæna,	0	0	0	0	0	1	96	3,900	1,700	350	16	0
Chroöcoccus,	0	0	0	0	45	0	0	0	0	0	0	0
Clathrocystis,	4	0	3	0	1	0	60	200	250	100	8	9
Cœlosphærium,	0	0	0	0	0	0	2	50	50	0	0	0
Microcystis,	0	0	0	0	1	4	6	0	0	0	0	0
Algæ,	0	0	0	6	53	132	8	0	50	100	29	5
Arthrodesmus,	0	0	0	0	0	5	0	0	0	0	0	1
Chlorococcus,	0	0	0	0	40	0	1	0	0	0	0	0
Pediastrum,	0	0	0	0	1	1	5	0	0	0	0	0
Protococcus,	0	0	0	0	0	109	0	0	0	0	4	4
Raphidium,	0	0	0	0	2	0	1	0	0	0	20	0
Staurastrum,	0	0	0	0	10	17	1	0	50	100	5	0
Zoöspores,	0	0	0	6	0	0	0	0	0	0	0	0
Fungi, Crenothrix,	0	0	0	1	2	17	11	0	0	0	2	0
ANIMALS.												
Infusoria,	0	133	0	120	665	0	8	200	100	0	12	236
Ciliated infusorian,	0	0	0	23	0	0	0	0	0	0	0	0
Dinobryon,	0	0	0	46	0	0	0	0	0	0	0	146
Dinobryon cases,	0	124	0	0	2	0	0	0	0	0	0	0
Euglena,	0	1	0	0	0	0	0	0	0	0	0	1
Mallomonas,	0	0	0	2	0	0	0	0	0	0	0	13
Monas,	0	0	0	2	0	0	0	150	100	0	0	0
Peridinium,	0	6	0	40	0	0	1	0	0	0	2	76
Trachelomonas,	0	2	0	1	660	0	7	50	0	0	10	0
Uroglena,	0	0	0	6	3	0	0	0	0	0	0	0
Vermes,	0	1	0	0	15	0	0	0	0	0	0	0
Monocerca,	0	1	0	0	2	0	0	0	0	0	0	0
Polyarthra,	0	0	0	0	13	0	0	0	0	0	0	0
Miscellaneous,	0	0	0	0	6	0	.20	0	0	0	0	0
Acarina,	0	0	0	0	.01	0	.20	0	0	0	0	0
Zoöglœa,	0	0	0	0	6	0	0	0	0	0	0	0
TOTAL,	4	134	3	130	1,400	155	197	4,350	2,200	700	82	271

LYNN AND SAUGUS.

Chemical Examination of Water from the Saugus River at Howlett's Dam, Saugus.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13632	Jan. 8	Slight.	Slight.	1.40	9.50	4.10	.0106	.0344	.0334	.0010	.97	.0200	.0003	1.5210	3.9
13809	Feb. 12	V. slight.	V. slight.	1.25	9.70	3.20	.0142	.0298	.0286	.0012	1.03	.0250	.0003	1.4800	4.2
13971	Mar. 12	V. slight.	Slight.	0.85	6.25	2.45	.0064	.0230	.0206	.0024	.60	.0220	.0005	0.7839	2.1
14119	Apr. 9	V. slight.	Slight.	0.90	5.80	2.55	.0048	.0250	.0238	.0012	.54	.0120	.0002	0.8162	1.9
14286	May 13	V. slight.	Cons.	2.55	8.75	3.95	.0148	.0510	.0482	.0028	.74	.0100	.0007	2.2516	3.0
14458	June 11	Slight.	Cons., brown.	1.15	7.25	3.85	.0034	.0342	.0290	.0052	.88	.0070	.0006	0.9890	2.5
14636	July 16	Slight.	Slight.	1.35	8.85	4.00	.0018	.0496	.0446	.0050	1.05	.0050	.0001	1.0140	3.4
14830	Aug. 12	Slight.	Slight, rusty.	1.90	9.60	4.90	.0036	.0620	.0548	.0072	.90	.0070	.0001	2.5740	3.1
15133	Sept. 9	Distinct.	Slight.	0.95	9.65	4.40	.0106	.0402	.0380	.0022	1.35	.0020	.0001	1.0452	3.5
15341	Oct. 9	V. slight.	Slight.	0.65	9.40	3.45	.0000	.0340	.0286	.0054	1.49	.0000	.0000	0.7644	4.4
15527	Nov. 12	V. slight.	V. slight.	1.30	8.00	3.40	.0048	.0388	.0362	.0026	.92	.0300	.0005	1.2542	2.7
15712	Dec. 9	V. slight.	V. slight.	1.25	7.25	3.25	.0016	.0350	.0328	.0022	.77	.0100	.0002	1.2246	2.9
Av.	1895	....	....	1.29	8.33	3.62	.0064	.0381	.0349	.0032	.94	.0125	.0003	1.3098	3.1
Av.	1894	....	....	1.16	8.68	3.36	.0056	.0310	.0272	.0038	1.03	.0112	.0014	0.9529	3.5

NOTE to analyses of 1895: Odor, vegetable, and frequently mouldy or unpleasant. —— The samples were collected from the river at Howlett's Dam.

Chemical Examination of Water from the Saugus River at the Line between Saugus and Wakefield, and just above the Point where it is joined by the Wakefield Branch.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13633	Jan. 8	Slight.	Slight.	1.55	9.55	3.70	.0062	.0376	.0366	.0010	.86	.0030	.0000	1.6770	4.0
13810	Feb. 12	V. slight.	Slight.	1.40	9.90	3.80	.0060	.0324	.0322	.0002	.91	.0030	.0000	1.6000	4.7
13972	Mar. 12	V slight.	Cons.	0.90	5.90	2 50	.0014	.0220	.0200	.0020	.53	.0050	.0001	0.8701	2.1
14120	Apr. 9	V. slight.	Cons., earthy.	0.85	4.35	1.90	.0030	.0222	.0180	.0042	.50	.0150	.0001	0.7069	1.3
14287	May 13	V. slight.	Cons.	2.40	8.60	4.40	.0026	.0496	.0444	.0052	.68	.0050	.0001	2.5280	3.0
14459	June 11	V. slight.	Cons.	1.30	5.65	2.35	.0008	.0320	.0306	.0014	.72	.0030	.0001	1.1739	2.9
14637	July 16	V. slight.	Slight.	1.80	7.95	4.10	.0010	.0446	.0436	.0010	.67	.0050	.0001	1.7160	3.2
14831	Aug. 12	V. slight.	V. slight.	1.90	9.35	4.70	.0028	.0508	.0480	.0028	.66	.0030	.0002	2.1450	3.6
15135	Sept. 9	Distinct.	Slight.	1.00	8.55	3.45	.0026	.0310	.0294	.0016	.88	.0000	.0001	1.0920	4.0
15342	Oct. 9	V. slight.	V. slight.	0.80	8.55	3.00	.0008	.0336	.0306	.0030	.83	.0000	.0000	0.9149	4.6
15528	Nov. 12	V. slight.	Slight.	1.40	6.60	3.20	.0012	.0390	.0368	.0022	.54	.0080	.0000	1.4547	2.5
15713	Dec. 9	V. slight.	V. slight.	1.35	7.40	3.35	.0004	.0356	.0328	.0028	.72	.0020	.0000	1.3026	2.9
Av.	1895	....	....	1.39	7.70	3.37	.0024	.0359	.0336	.0023	.71	.0043	.0001	1.4318	3.2
Av.	1894	....	....	1.18	7.71	3.00	.0017	.0288	.0260	.0027	.62	.0038	.0000	1.0063	3.2

NOTE to analyses of 1895: Odor, in January, decidedly disagreeable; at other times, vegetable and sometimes also mouldy. —— The samples were collected from the Saugus River, at a road crossing at the upper end of Howlett's Pond, just above the point where the river is joined by the Wakefield branch.

LYNN AND SAUGUS.

Chemical Examination of Water from a Faucet in Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites		
	1895.														
13631	Jan. 8	Slight.	Slight.	0.93	6.55	2.75	.0040	.0212	.0198	.0014	.78	.0130	.0001	0.8775	2.3
13811	Feb. 12	V. slight.	Slight.	1.05	7.60	2.70	.0060	.0228	.0226	.0002	.87	.0200	.0002	0.9360	2.9
13973	Mar. 12	V. slight.	Slight.	0.73	5.65	1.95	.0040	.0166	.0152	.0014	.67	.0180	.0002	0.7916	1.7
14121	Apr. 9	V slight.	Slight.	0.62	4.50	2.05	.0008	.0156	.0142	.0014	.54	.0160	.0000	0.5898	1.4
14288	May 13	V. slight.	Slight.	1.50	6.15	2.60	.0008	.0336	.0318	.0018	.74	.0070	.0001	1.7380	2.5
14460	June 11	Slight.	Cons., brown.	0.70	4.05	2.10	.0000	.0236	.0196	.0040	.48	.0120	.0001	0.6240	1.1
14638	July 16	V. slight.	Cons.	0.95	4.90	2.25	.0014	.0252	.0230	.0022	.62	.0120	.0001	1.5600	1.7
14832	Aug. 12	Distinct.	Slight, rusty.	0.40	4.70	2.00	.0004	.0268	.0180	.0088	.69	.0030	.0001	0.4914	1.6
15134	Sept. 9	Distinct.	Slight.	0.60	4.35	1.95	.0004	.0208	.0162	.0046	.66	.0020	.0001	0.5538	1.9
15343	Oct. 9	V. slight.	Slight, brown.	0.40	4.15	1.80	.0022	.0222	.0190	.0032	.67	.0050	.0000	0.4524	1.6
15529	Nov. 12	Slight.	Slight.	0.55	4.60	1.75	.0000	.0196	.0168	.0028	.60	.0120	.0001	0.6591	1.1
15714	Dec. 9	V. slight.	Slight.	0.88	4.20	1.75	.0004	.0216	.0176	.0040	.44	.0030	.0000	0.7527	0.9
Av.	1895	....	....	0.78	5.12	2.14	.0017	.0225	.0195	.0030	.65	.0102	.0001	0.8355	1.7
Av.	1894	....	....	0.76	4.60	1.95	.0023	.0216	.0194	.0022	.57	.0065	.0001	0.6234	1.3

NOTE to analyses of 1895: Odor, generally vegetable, sometimes also mouldy or unpleasant, very rarely none. —— The samples were collected from a faucet in the city.

Microscopical Examination of Water from a Faucet in Lynn.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	14	14	10	14	13	18	15	12	11	14	12
Number of sample,	13631	13811	13973	14121	14288	14460	14638	14832	15134	15343	15529	15714
PLANTS.												
Diatomaceæ,	**0**	**0**	**2**	**6**	**19**	**4**	**137**	**868**	**277**	**42**	**76**	**13**
Asterionella,	0	0	0	2	8	0	48	60	120	9	32	1
Cyclotella,	0	0	0	1	7	2	72	48	0	0	1	0
Melosira,	0	0	0	0	0	0	2	0	9	12	38	12
Synedra,	0	0	2	3	4	0	2	0	8	4	0	0
Tabellaria,	0	0	0	0	0	2	13	760	140	17	5	0
Cyanophyceæ, Merismopedia,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**
Algæ,	**0**	**1**	**0**	**0**	**0**	**279**	**42**	**48**	**22**	**31**	**0**	**1**
Arthrodesmus,	0	0	0	0	0	0	5	0	0	1	0	1
Protococcus,	0	1	0	0	0	278	34	23	0	9	0	0
Raphidium,	0	0	0	0	0	0	2	1	0	15	0	0
Staurastrum,	0	0	0	0	0	1	1	2	22	4	0	0
Staurogenia,	0	0	0	0	0	0	0	22	0	2	0	0
Fungi,	**136**	**3**	**15**	**4**	**124**	**9**	**84**	**52**	**84**	**156**	**4**	**1**
Crenothrix,	0	3	15	4	124	9	84	52	84	156	4	1
Euglypha,	136	0	0	0	0	0	0	0	0	0	0	0

LYNN AND SAUGUS.

Microscopical Examination of Water from a Faucet in Lynn — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Jan	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
ANIMALS.												
Infusoria,	**2**	**0**	**1**	**3**	**0**	**0**	**68**	**39**	**60**	**5**	**10**	**4**
Ciliated infusorian,	0	0	0	0	0	0	7	0	0	0	0	0
Cryptomonas,	2	0	0	0	0	0	0	0	0	0	0	0
Dinobryon,	0	0	0	0	0	0	0	0	0	0	9	0
Dinobryon cases,	0	0	0	0	0	0	21	32	32	0	0	0
Mallomonas,	0	0	0	0	0	0	0	0	0	1	1	0
Monas,	0	0	0	0	0	0	0	0	0	0	0	4
Peridinium,	0	0	1	3	0	0	4	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	36	7	28	4	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**200**	**600**	**100**	**0**
TOTAL,	138	4	18	13	143	292	331	1,014	643	834	190	19

Chemical Examination of Water from Cedar Brook above Sluice Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
13689	1895. Jan. 17	V. slight.	Slight.	.67	3.80	1.70	.0002	.0098	.0082	.0016	.49	.0050	.0000	.5672	0.6

Odor, very faintly vegetable, becoming stronger on heating.

Microscopical Examination.

Diatomaceæ, *Fragilaria*, 4; *Synedra*, 1. Fungi, *Crenothrix*, 1. Total, 6.

Table showing Monthly Depth of Water in Feet in the Ponds and Storage Reservoirs of the Lynn Water Works during the Year 1895.

	Breed's Pond. High Water, 21.50 Feet.	Birch Pond. High Water, 21.50 Feet.*	Walden Pond. High Water, 17.00 Feet.	Glen Lewis Pond. High Water, 17 00 Feet.*
Jan. 1,	11.92	14.67	-	15.50
Feb. 2,	14.04	17.75	-	16.79
March 4,	13.71	17.92	-	17.42
April 1,	16.17	19.08	11.08	17.50
May 6,	19.63	22.17	14.33	17.50
June 1,	20.63	22.54	13.50	17.42
July 1,	20.50	22.17	9.83	17.42
Aug. 1,	20.13	18.33	4.00	17.46
Sept. 2,	19.75	12.75	-	17.46
Oct. 1,	18.92	7.00	-	17.42
Nov. 2,	17.00	8.75	-	18.13
Dec. 1,	20.08	18.92	-	18.00

* The water in these ponds is sometimes raised somewhat above ordinary high water.

Water Supply of Malden, Medford and Melrose.

Chemical Examination of Water from Spot Pond, Stoneham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13601	Jan. 3	Slight.	Slight.	.30	7.20	2.30	.0032	.0238	.0220	.0018	.69	.0040	.0000	.3619	3.2
13719	Jan. 25	None.	V. slight.	.20	6.95	1.60	.0050	.0204	.0188	.0016	.70	.0170	.0000	.3120	2.7
13732	Jan. 28	V. slight.	V. slight.	.18	5.90	1.55	.0020	.0176	.0138	.0038	.68	.0170	.0001	.3476	2.5
13780	Feb. 5	V. slight.	V. slight.	.15	7.10	1.85	.0030	.0198	.0176	.0022	.72	.0180	.0000	.3318	2.7
13942	Mar. 5	Distinct.	Cons.	.12	5.70	1.85	.0150	.0202	.0184	.0018	.58	.0180	.0000	.3296	2.7
14099	Apr. 2	Slight.	Slight.	.28	5.30	1.50	.0076	.0162	.0148	.0014	.58	.0170	.0000	.4312	2.5
14269	May 6	V. slight.	Cons.	.23	5.20	1.80	.0052	.0170	.0156	.0014	.58	.0120	.0001	.4273	2.2
14437	June 3	Slight.	Slight, yellow.	.28	5.50	2.25	.0066	.0228	.0210	.0018	.59	.0030	.0001	.4940	2.2
14606	July 9	Distinct.	Cons.	.28	6.30	2.10	.0002	.0308	.0276	.0032	.59	.0030	.0000	.5372	2.3
14781	Aug. 5	Distinct.	Cons.	.25	5.75	2.25	.0006	.0226	.0190	.0036	.60	.0080	.0000	.4992	2.5
15049	Sept. 4	Distinct.	Slight.	.20	6.00	2.10	.0026	.0232	.0202	.0030	.64	.0020	.0001	.4540	2.7
15313	Oct. 3	V. slight.	Cons.	.23	5.60	2.00	.0030	.0212	.0190	.0022	.62	.0000	.0000	.3806	2.5
15594	Nov. 19	V. slight.	V. slight.	.38	6.30	2.35	.0082	.0268	.0238	.0030	.59	.0130	.0001	.5031	2.2
15703	Dec. 8	V. slight.	Slight.	.40	5.65	2.40	.0142	.0222	.0206	.0016	.50	.0080	.0001	.5226	2.1
Av*	....	....	....	.25	5.92	2.02	.0058	.0219	.0196	.0023	.61	.0096	.0000	.4376	2.4

Averages by Years.

-	1887†	-	-	.25	4.33	1.24	.0004	.0207	-	-	.46	.0025	-	-	-
-	1888	-	-	.22	3.98	1.24	.0007	.0225	-	-	.44	.0054	.0001	-	-
-	1889	-	-	.26	3.54	1.17	.0017	.0236	.0198	.0038	.44	.0053	.0002	-	-
-	1890	-	-	.24	3.96	1.24	.0019	.0220	.0180	.0040	.42	.0069	.0001	-	1.7
-	1891	-	-	.21	3.70	1.27	.0008	.0183	.0161	.0022	.43	.0082	.0001	-	1.4
-	1892	-	-	.17	4.28	1.30	.0035	.0198	.0157	.0041	.50	.0081	.0001	-	1.7
-	1893	-	-	.29	5.70	1.71	.0085	.0197	.0162	.0035	.49	.0105	.0003	.3486	2.4
-	1894	-	-	.23	5.90	1.68	.0029	.0210	.0160	.0050	.57	.0039	.0001	.3616	2.4
-	1895	-	-	.25	5.92	2.02	.0058	.0219	.0196	.0023	.61	.0096	.0000	.4376	2.4

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

† May to December.

Note to analyses of 1895: Odor, generally vegetable, sometimes also disagreeable, rarely none. —— The samples were collected from the pond.

MALDEN, MEDFORD AND MELROSE.

Microscopical Examination of Water from Spot Pond, Stoneham.

[Number of organisms per cubic centimeter.]

	1895.													
	Jan.	Jan.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, .	5	29	31	9	8	6	10	8	12	10	10	8	23	12
Number of sample, .	13601	13719	13732	13780	13942	14099	14269	14437	14606	14781	15049	15313	15594	15703
PLANTS.														
Diatomaceæ, . .	**13**	**0**	**2**	**pr.**	**0**	**0**	**350**	**994**	**11**	**38**	**165**	**40**	**105**	**159**
Asterionella, . .	8	0	0	0	0	0	36	574	0	0	164	28	13	41
Cyclotella, . .	1	0	2	0	0	0	156	418	2	4	1	0	2	2
Melosira, . . .	0	0	0	0	0	0	0	0	0	0	0	12	2	26
Synedra, . . .	2	0	0	pr.	0	0	156	2	3	32	0	0	0	0
Tabellaria, . .	2	0	0	0	0	0	2	0	6	2	0	0	88	90
Cyanophyceæ, Anabæna, . . .	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**108**	**1**	**0**	**0**	**0**	**0**
Algæ, ...	**0**	**0**	**0**	**0**	**0**	**0**	**27**	**0**	**153**	**20**	**3**	**28**	**3**	**1**
Protococcus, . .	0	0	0	0	0	0	18	0	146	17	0	24	0	0
Raphidium, . .	0	0	0	0	0	0	0	0	4	3	3	4	3	1
Scenedesmus, . .	0	0	0	0	0	0	9	0	3	0	0	0	0	0
Fungi, Crenothrix, .	**0**	**0**	**1**	**0**	**1**	**2**	**3**	**5**	**6**	**32**	**2**	**14**	**5**	**3**
ANIMALS.														
Infusoria, . . .	**29**	**1**	**2**	**7**	**10**	**1**	**4**	**0**	**45**	**7**	**4**	**129**	**1**	**0**
Dinobryon, . .	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Dinobryon cases, .	0	0	0	0	0	1	4	0	0	0	0	126	0	0
Peridinium, . .	1	1	2	7	9	0	0	0	36	7	4	0	0	0
Trachelomonas, .	1	0	0	0	1	0	0	0	4	0	0	3	1	0
Uroglena, . . .	27	0	0	0	0	0	0	0	2	0	0	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**48**	**40**	**0**	**0**	**0**	**0**	**0**	**5**	**20**
TOTAL, . . .	42	1	5	7	11	51	424	999	323	98	174	211	119	183

Table showing Heights of Water in Spot Pond on the First of Each Month in 1895.

DATE.	Distance Below High-water Mark.	DATE.	Distance Below High-water Mark.
	Feet.		Feet.
Jan. 1, ...	7.19	July 1, ...	3.27
Feb. 1, ...	6.04	Aug. 1, ...	4.08
March 1, ...	6.15	Sept. 1, ...	4.94
April 1, ...	4.02	Oct. 1, ...	6.19
May 1, ...	2.50	Nov. 1, ...	5.35
June 1, ...	2.44	Dec. 1, ...	2.38

Water Supply of Malden.

Chemical Examination of Water from Tubular Wells at Maplewood (Webster Park), Malden.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13602	Jan. 3	None.	None.	.01	29.20	.0004	.0020	2.78	.3750	.0000	.0038	15.8	.0040
13781	Feb. 5	None.	None.	.01	29.40	.0000	.0016	2.55	.4500	.0000	.0118	15.0	.0020
13943	Mar. 5	None.	None.	.00	31.90	.0000	.0018	2.40	.4000	.0000	.0200	16.0	.0000
14100	Apr. 2	Slight.	Slight, earthy.	.02	32.20	.0004	.0010	2.60	.4900	.0000	.0400	12.4	.0340
14270	May 6	V. slight.	Slight.	.00	32.60	.0000	.0028	2.60	.4500	.0000	.0038	13.0	.0140
14438	June 3	None.	None.	.00	34.20	.0000	.0022	2.70	.3650	.0001	.0342	13.0	.0050
14607	July 9	None.	None.	.00	33.10	.0002	.0020	2.70	.5250	.0000	.0395	12.9	.0020
14782	Aug. 5	None.	None.	.00	33.80	.0000	.0010	2.90	.5000	.0000	.0390	17.5	.0050
15048	Sept. 4	None.	None.	.00	35.00	.0000	.0006	3.00	.4000	.0001	.0819	14.5	.0320
15314	Oct. 3	None.	V. slight.	.02	30.50	.0000	.0006	2.95	.4750	.0000	.0273	16.4	.0050
15595	Nov. 19	None.	None.	.00	31.50	.0000	.0014	2.81	.4500	.0000	.0390	15.9	.0030
15704	Dec. 8	None.	V. slight.	.00	30.90	.0000	.0014	2.74	.3000	.0000	.0429	16.0	.0050
Av.	....	....	....	.00	32.02	.0001	.0015	2.73	.4317	.0000	.0319	14.9	.0092

Averages by Years.

-	1887*	-	-	.00	17.03	.0000	.0008	2.20	.4050	-	-	-	-
-	1888	-	-	.00	17.45	.0000	.0003	2.30	.5081	-	-	-	-
-	1889†	-	-	.00	16.95	.0001	.0031	1.75	.5500	.0001	-	7.3	-
-	1890	-	-	.00	18.19	.0002	.0014	2.30	.4904	.0001	-	8.0	-
-	1891	-	-	.00	20.83	.0001	.0007	2.23	.5146	.0001	-	9.6	-
-	1892	-	-	.00	23.00	.0000	.0005	2.36	.5129	.0000	-	11.4	-
-	1893	-	-	.00	23.72	.0001	.0011	2.48	.4823	.0000	.0186	11.1	.0033
-	1894	-	-	.00	28.23	.0000	.0012	2.74	.3946	.0000	.0172	13.2	.0058
-	1895	-	-	.00	32.02	.0001	.0015	2.73	.4317	.0000	.0319	14.9	.0092

* Three samples in November and December. † June and October.

Note to analyses of 1895: Odor, none. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

A small number of organisms, chiefly *Crenothrix* and *Zoöglœa*, was found in some of these samples.

MANCHESTER.

WATER SUPPLY OF MANCHESTER.

The works for obtaining a supply of water for the town of Manchester were extended in 1895 by sinking five 4-inch tubular wells in the valley of Sawmill Brook near Coolidge Spring, a short distance above the large well. The wells were driven to depths ranging from 27 to 34 feet, and water is pumped from them through a 6-inch pipe into the large well near the pumping station.

Chemical Examination of Water from the Well of the Manchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed	Hardness.	Iron.
	1895.												
13705	Jan. 23	None.	None.	.02	10.00	.0000	.0002	1.89	.0600	.0000	.0047	3.5	.0070
14208	Apr. 23	None.	V. slight	.00	10.20	.0002	.0010	1.94	.0730	.0000	.0197	3.5	.0010
14835	Aug. 13	None.	Slight.	.00	9.70	.0000	.0000	1.62	.0750	.0001	.0234	2.9	.0080
15422	Oct. 24	None.	None.	.00	9.60	.0004	.0008	1.76	.0870	.0000	.0195	3.4	.0000
Av.	....	....	....	.01	9.87	.0001	.0005	1.80	.0737	.0000	.0168	3.3	.0040

Averages by Years.

-	1892	-	-	.00	9.38	.0001	.0003	1.75	.1214	.0001	-	3.4	-
-	1893	-	-	.00	9.64	.0000	.0002	1.69	.0975	.0000	.0370	3.5	.0096
-	1894	-	-	.00	9.82	.0000	.0006	1.82	.0700	.0000	.0066	3.4	.0010
-	1895	-	-	.01	9.87	.0001	.0005	1.80	.0737	.0000	.0168	3.3	.0040

Odor, none. —— The samples were collected from the well.

Microscopical Examination.

No organisms.

Chemical Examination of Water from Tubular Wells near Coolidge Spring, used as an Additional Source of Water Supply for Manchester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14834	Aug. 13	None.	None.	.00	8.70	.0000	.0002	1.42	.2000	.0001	.0390	2.7	.0000

Odor, none. —— The sample was collected from a pump drawing water from the wells.

Microscopical Examination.

No organisms.

MANCHESTER.

Chemical Examination of Water from Cat Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
14367	1895. May 24	V. slight.	Cons.	1.20	4.95	2.55	.0000	.0146	.0130	.0016	.92	.0000	.0000	.9880	0.5

Odor, decidedly vegetable. —— The sample was collected from the brook, about half a mile above the pumping station of the Manchester water works.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

Water Supply of Mansfield Water Supply District, Mansfield.

Chemical Examination of Water from the Well of the Mansfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14585	1895. July 8	None.	None.	.00	2.60	.0000	.0000	.31	.0070	.0000	.0237	0.5	.0000

Odor, none. —— The sample was collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

Water Supply of Marblehead.

During the year 1895 the small collecting well which was built in 1893 near a small pond in the vicinity of the pumping station was replaced by a large well constructed in the bed of the pond. The well is 25 feet in diameter and 34 feet deep, and is sunk through about 20 feet of mud into a bed of gravel. Water from this well is used at the times when the quantity of water furnished by the original well is insufficient for the supply of the town.

MARBLEHEAD.

Chemical Examination of Water from Faucets in Marblehead supplied from the Marblehead Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13980	Mar. 14	None.	None.	.02	13.40	.0014	.0032	2.20	.0300	.0000	.0360	6.6	.0120
14309	May 15	Slight.	None.	.04	14.70	.0000	.0014	2.00	.0480	.0000	.0158	7.0	.0120
14310	May 15	V. slight.	None.	.04	15.80	.0000	.0014	2.10	.0380	.0000	.0253	6.6	.0020
14709	July 25	Distinct, milky.	Slight.	.10	14.60	.0040	.0016	2.30	.0150	.0000	.0385	7.1	.0330
15252	Sept. 24	Slight, milky.	V. slight.	.10	15.10	.0000	.0010	2.10	.0350	.0000	.0000	6.4	.0200
15620	Nov. 25	V. slight.	V. slight.	.03	16.90	.0000	.0006	2.69	.0520	.0000	.0507	8.4	.0040
Av.*	....	....	....	.06	15.05	.0011	.0016	2.27	.0350	.0000	.0291	7.1	.0152

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor of the first sample, faintly musty; of the others, none.

Microscopical Examination.

No organisms.

WATER SUPPLY OF MARLBOROUGH.

During 1895 a storage reservoir was constructed on Millham Brook near its junction with the Assabet River, and a short distance below the point from which water has been pumped during a portion of the last two years for the supply of the city. The reservoir has an area of about 66 acres, and its general depth is about 25 feet. Its total storage capacity when full is 315,000,000 gallons, but by the present arrangement the available capacity above the entrance to the pipe leading to the pumping station, which is 14 feet below high water, is about 262,000,000 gallons. The area flowed contained a meadow having an area of about 30 acres, where the mud was from 3 to 6 feet in depth. The mud was not disturbed, and the only preparation which the surface received was the burning of the grass. The bottom of the reservoir at the sides was stripped of loam and vegetable matter above a level 10 feet below high water, and the stumps were removed. The loam taken from this portion of the reservoir was used in filling the shallow places, and was covered with gravel to a depth of 6 inches, making steep slopes around the shores, so that the depth is generally not less than 6 feet at high water. The watershed, exclusive of the watershed of Lake

Williams, the present source of supply, has an area of about 3.56 square miles and contains considerable population, located chiefly at the upper end.

Water from this reservoir will be supplied to the city when required by pumping at the present pumping station on Millham Brook, near the upper end of the reservoir. By means of this pumping station water can be forced to the pumping station at Lake Williams, and either discharged into the lake or pumped again to the distributing reservoir for the supply of the city.

During the spring of 1895 46,500,000 gallons of water were pumped from Millham Brook above the storage reservoir into Lake Williams, the present source of supply. This is about a quarter of the total quantity of water consumed by the city during the year.

Chemical Examination of Water from Lake Williams, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14009	Mar. 19	V. slight.	V. slight.	.15	4.25	1.05	.0004	.0172	.0130	.0042	.51	.0180	.0000	.3041	2.2
14185	Apr. 17	Slight.	Cons.	.12	4.70	2.00	.0006	.0162	.0152	.0010	.45	.0150	.0000	.3002	1.7
14322	May 17	Slight.	Slight.	.08	3.70	1.40	.0006	.0180	.0162	.0018	.46	.0000	.0000	.2528	1.9
15424	Oct. 23	Slight.	Slight.	.10	3.80	0.95	.0006	.0190	.0178	.0012	.49	.0030	.0000	.2769	1.7
Av.	....	....	....	.11	4.11	1.35	.0005	.0176	.0156	.0020	.48	.0090	.0000	.2835	1.9

Averages by Years.

-	1887*	-	-	.08	4.10	0.65	.0010	.0178	-	-	.45	.0017	-	-	-
-	1888	-	-	.05	3.99	0.91	.0005	.0205	-	-	.44	.0054	.0001	-	-
-	1889	-	-	.04	3.92	1.03	.0007	.0220	.0182	.0038	.46	.0064	.0001	-	-
-	1890	-	-	.03	4.41	1.13	.0007	.0206	.0165	.0041	.46	.0078	.0000	-	2.3
-	1891	-	-	.05	4.12	1.20	.0009	.0197	.0162	.0035	.45	.0072	.0001	-	1.8
-	1892†	-	-	.08	4.30	1.48	.0008	.0244	.0174	.0070	.46	.0115	.0003	-	1.7
-	1893	-	-	.05	3.95	0.88	.0014	.0169	.0136	.0033	.40	.0033	.0000	.2012	1.7
-	1894	-	-	.09	4.20	1.21	.0001	.0154	.0136	.0019	.45	.0030	.0000	.2246	1.7
-	1895	-	-	.11	4.11	1.35	.0005	.0176	.0156	.0020	.48	.0090	.0000	.2835	1.9

* June to December. † March and April.

Note to analyses of 1895: Odor of the first and last samples, faintly vegetable; of the second, none, becoming distinctly vegetable and somewhat unpleasant on heating; of the third, distinctly unpleasant, disappearing on heating. —— The first and third samples were collected from a faucet at the pumping station while pumping, and the other samples from the lake.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14009, 29; No. 14185, 79; No. 14322, 227; No. 15424, 81.

MARLBOROUGH.

Chemical Examination of Water from Millham Brook near its Entrance to the Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14008	Mar. 19	V. slight.	V. slight.	0.48	4.00	1.25	.0026	.0152	.0136	.0016	.31	.0280	.0001	.4937	2.1
14184	Apr. 17	None.	V. slight.	0.55	4.20	1.90	.0018	.0136	.0124	.0012	.36	.0280	.0002	.5230	1.6
14323	May 17	V. slight.	Slight.	1.10	5.05	2.35	.0002	.0238	.0232	.0006	.28	.0070	.0001	.8176	1.8
15423	Oct. 23	V. slight.	V. slight.	0.90	5.40	2.00	.0004	.0236	.0220	.0016	.39	.0130	.0001	.8541	1.9
15493	Nov. 6	None.	Slight.	0.73	5.75	2.40	.0002	.0190	.0176	.0014	.44	.0240	.0001	.7738	1.9
15698	Dec. 9	V. slight.	V. slight.	0.50	4.55	1.75	.0006	.0140	.0124	.0016	.28	.0300	.0000	.4914	1.6
Av.	....	... .	....	0.71	4.83	1.94	.0010	.0182	.0169	.0013	.34	.0217	.0001	.6589	1.8

Odor, faintly vegetable; generally stronger on heating. —— The first four samples were collected from a small reservoir, just above the Millham Brook reservoir, from which water was pumped for the supply of the city; the last two samples, from the brook just above the small reservoir.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14008, 9; No. 14184, 8; No. 14323, 240; No. 15423, 49; No. 15493, 26; No. 15698, 3.

Chemical Examination of Water from the North Branch of Millham Brook near its entrance to the Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
15492	Nov. 6	Slight.	Slight.	1.70	7.20	3.95	.0006	.0314	.0302	.0012	.54	.0080	.0000	1.9890	1.6
15699	Dec. 9	None.	V. slight.	1.15	5.15	2.10	.0004	.0210	.0194	.0016	.35	.0120	.0000	0.9243	1.3

Odor of the first sample, distinctly vegetable and mouldy; of the last, faintly vegetable.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 15492, 77; No. 15699, 6.

MARLBOROUGH.

Chemical Examination of Water from Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
15494	Nov. 6	Distinct.	Slight.	1.20	6.15	3.35	.0002	.0392	.0346	.0046	.32	.0120	.0002	1.3884	1.7
15700	Dec. 8	V. slight.	Slight.	1.00	5.00	2.20	.0016	.0334	.0286	.0048	.26	.0050	.0002	0.8674	1.6

Odor of the first sample, distinctly vegetable; of the last, faintly vegetable. —— The samples were collected from the reservoir, near the dam.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 15494, 347; No. 15700, 153.

Water Supply of Brant Rock, Marshfield. — Brant Rock Water Company.

Chemical Examination of Water from the Works of the Brant Rock Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14648	July 16	None.	None.	.00	11.50	.0004	.0024	3.00	.1100	.0000	.0450	2.2	.0000

Odor, none. —— The sample was collected from a faucet at the pumping station.

Microscopical Examination.

No organisms.

Water Supply of Maynard.

In 1895 an open receiving chamber was constructed near the pumping station, into which the conduit from White Pond discharges. The chamber is 70 feet long, 40 feet wide and 17 feet deep, the side walls being built of masonry and the bottom of con-

MAYNARD.

crete. Water passes from the receiving chamber into the old pump well. When the water in the receiving chamber is drawn to a low level it is said that there is a considerable infiltration of ground water.

Chemical Examination of Water from White Pond, Maynard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14345	May 22	Distinct.	Slight.	.02	2.20	1.15	.0000	.0152	.0136	.0016	.30	.0000	.0000	.1444	0.2
15415	Oct. 23	Distinct, green.	Slight, green.	.04	1.95	0.85	.0004	.0268	.0194	.0074	.27	.0050	.0000	.1700	0.2

Odor of the first sample, distinctly vegetable, becoming also unpleasant on heating; of the second sample, none.—— The samples were collected from the pond.

Microscopical Examination.

No. 14345. Diatomaceæ, *Asterionella*, 72; *Cyclotella*, 80; *Diatoma*, 1; *Melosira*, 1; *Navicula*, 1; *Pleurosigma*, 1; *Synedra*, 78; *Tabellaria*, 35. Cyanophyceæ, *Merismopedia*, 2; *Microcystis*, 32. Algæ, *Protococcus*, 5; *Raphidium*, 11. Infusoria, *Dinobryon*, 8; *Dinobryon cases*, 108. Miscellaneous, *Zoöglœa*, 52. Total, 487.

No. 15415. Diatomaceæ, *Asterionella*, 4; *Synedra*, 10; *Tabellaria*, 28. Cyanophyceæ, *Microcystis*, 284. Algæ, *Glœocapsa*, 5; *Raphidium*, 11. Infusoria, *Peridinium*, 1. Miscellaneous, *Zoöglœa*, 7. Total, 350.

MEDFIELD.

Chemical Examination of Water from a Spring, Medfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14920	Aug. 28	None.	None.	.01	4.00	.0050	.0026	.36	.0000	.0000	.0468	1.1	.0050

Odor, none.—— The sample was collected from a spring near Vine Brook, about one-third of a mile above North Street. This spring is used as a source of water supply by a large straw factory and by a portion of the village of Medfield.

Microscopical Examination.

No organisms.

MEDFIELD.

Water Supply of Medfield Insane Asylum.

Chemical Examination of Water from a Tubular Well at the Medfield Insane Asylum.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14533	1895. June 24	V. slight.	V. slight.	.00	3.80	.0000	.0010	.37	.0050	.0000	.0346	0.9	.0070

Odor, none.——The sample was collected from the well.

Microscopical Examination.

No organisms.

Water Supply of Medford.

In 1895 a new dam at Wright's Pond was completed, increasing the storage capacity to about 72,000,000 gallons. The area of the pond at high water is now 23 acres, and its average depth about 10 feet. None of the soil was removed from the area flowed. The area of the watershed, including the area of the pond, is about 191 acres, consisting chiefly of wood land, and containing a very small population. Water from Wright's Pond may be pumped to supply the high-service system, or may be supplied to the town by gravity by means of a connection with the main pipe from Spot Pond to the town, which passes near Wright's Pond.

In connection with the high-service system there is a standpipe 35 feet in diameter and 60 feet in height.

In addition to the supply obtained from Wright's Pond, water is pumped at times for the supply of the city from two tributaries of the brook flowing from Wright's Pond, known as the East Arm and the West Arm. The water from these sources and from Wright's Pond can be pumped into Spot Pond if desired.

Further information regarding the water supply of Medford from Spot Pond and analyses of the water of this pond may be found on pages 217 and 218 of this volume.

MEDFORD.

Chemical Examination of Water from Wright's Pond, Medford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14443	June 10	Distinct.	Cons.	.50	6.05	2.25	.0068	.0252	.0220	.0032	.58	.0050	.0001	.6080	2.2
15666	Dec. 3	Slight.	Slight.	.50	5.55	2.15	.0064	.0214	.0194	.0020	.47	.0050	.0002	.5850	2.1

Odor of the first sample, vegetable; of the last, aromatic, becoming vegetable on heating.—— The first sample was collected from a faucet at the temporary pumping station while pumping water from the pond; the second, from Wright's Pond.

Microscopical Examination.

The total number of organisms per cubic centimeter found in each of these samples was as follows: No. 14443, 604; No. 15666, 189.

Chemical Examination of Water from a Brook near Wright's Pond, Medford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
15665	Dec. 3	Slight.	Slight, earthy.	.43	3.25	1.15	.0056	.0160	.0146	.0014	.45	.0100	.0003	.4680	1.8

Odor, faintly vegetable.—— The sample was collected from a brook entering the stream which forms the outlet of Wright's Pond from the east, and known as the east arm, just below the pond.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

MEDFORD.

Chemical Examination of Water from Underdrains beneath the Sewers, Medford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
14684	July 23	None.	V. slight.	.04	10.50	.0640	.0050	2.50	.0900	.0007	.0525	3.9	.0220
14685	July 23	V. slight.	Cons., yellow.	.04	347.20	.0960	.0050	161.00	.1350	.0011	.2962	64.5	.0200

Odor of the first sample, offensive; of the second, distinctly musty.——The first sample was collected from the underdrain in Spring Street near Charles Street; the second sample was collected from an underdrain in Boston Street near the Mystic River.

Microscopical Examination.

No. 14684. Fungi, *Crenothrix*, 1.
No. 14685. Fungi, *Crenothrix*, 226. Miscellaneous, *Zoöglœa*, 206. Total, 432.

Medway.

Chemical Examination of Water from Test Wells, Medway.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1895.												
14719	July 26	Slight, clayey.	Cons., sandy.	.05	5.75	.0052	.0042	0.58	.0030	.0000	.1155	2.2	.0175
14844	Aug. 15	V. slight.	V. slight.	.04	5.20	.0048	.0042	0.60	.0000	.0000	.1716	2.2	.0120
15050	Sept. 7	None.	None.	.02	6.30	.0020	.0024	0.67	.0030	.0000	.1544	2.5	.0100
14720	July 26	Distinct, clayey.	Heavy, sandy.	.03	13.15	.0020	.0010	1.44	.3150	.0003	.0385	4.2	.0150
14845	Aug. 15	Slight.	Cons., sandy.	.04	12.50	.0000	.0018	1.46	.1860	.0000	.0546	3.9	.0550
15051	Sept. 7	None.	None.	.00	15.00	.0000	.0000	1.65	.3333	.0000	.0312	4.2	.0100
15636	Nov. 29	None.	None.	.00	6.20	.0000	.0022	0.54	.0000	.0000	.0897	1.4	.0030
15637	Nov. 29	Slight.	Slight, earthy.	.03	7.70	.0000	.0004	0.64	.1000	.0000	.0156	3.1	.0050

Odor, none.——The samples were collected from tubular test wells near the Charles River, below the village of Medway, located as follows: the first three samples, from a well between Village Street and Charles River, just above Walker Street; the next three, from a well about 20 feet west of Village Street and 100 feet north of Walker Street; No. 15636, near the factory of Ray & Wilson, at the corner of Village and Walker streets; the last, from a well 100 feet west of Village Street and about 200 feet north of Walker Street. The samples were collected during an investigation of possible sources of water supply for the town of Medway.

Microscopical Examination.

No organisms.

MEDWAY.

Chemical Examination of Water from a Spring, Medway.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14718	1895. July 26	None.	V. slight.	.03	8.95	.0000	.0026	1.13	.1200	.0003	.0770	3.1	.0040

Odor, none.——The sample was collected from a roadside spring near Village Street, about 150 feet north of Walker Street.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

Chemical Examination of Water from the Charles River at Medway.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
14717	1895. July 26	Slight.	Slight, dark.	1.25	6.75	2.15	.0050	.0400	.0320	.0080	.57	.0050	.0002	1.1742	1.8

Odor, distinctly vegetable and mouldy.——The sample was collected from the river a short distance below the village of Medway, at Ray & Wilson's dam, just above Walker Street.

Microscopical Examination.

Diatomaceæ, *Synedra*, 2; *Tabellaria*, 1. Algæ, *Glœocapsa*, 32; *Pandorina*, 3; *Protococcus*, 9; *Scenedesmus*, 1; *Staurogenia*, 1. Fungi, *Crenothrix*, 460. Total, 509.

Water Supply of Melrose.

For information regarding the water supply of Melrose from Spot Pond and for analyses of water from the pond see pages 217 and 218.

The results of analyses of samples of water from the auxiliary ground-water supply introduced in 1894 are given in the following table: —

MELROSE.

Chemical Examination of Water from Tubular Wells in the Valley of Spot Pond Brook, near Wyoming Avenue, used as an Additional Source of Water Supply for Melrose.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13957	Mar. 11	V. slight.	Slight.	.05	10.30	.0016	.0054	1.17	.0520	.0001	.1478	4.3	.0050
14473	June 14	V. slight.	V. slight.	.08	13.80	.0000	.0026	1.49	.0450	.0001	.0741	6.4	.0190
14557	July 1	None.	None.	.10	13.30	.0000	.0044	1.26	.0830	.0000	.1556	5.9	.0100
15165	Sept. 13	None.	None.	.03	15.80	.0000	.0022	1.68	.0780	.0002	.0039	8.4	.0030
15276	Sept. 30	None.	None.	.03	10.60	.0004	.0006	1.40	.3900	.0002	.0094	4.2	.0200
15707	Dec. 9	None.	None.	.04	13.80	.0004	.0034	1.50	.0730	.0005	.0663	7.3	.0080
Av.	....	....	....	.06	12.88	.0004	.0034	1.39	.0974	.0002	.0901	6.0	.0107

Odor, none. —— No. 15276 was collected from a group of new wells; the other samples, from faucets in Melrose supplied from the tubular wells.

Microscopical Examination.

No. 13957. Fungi, *Crenothrix*, 7.
No. 15276. Fungi, *Molds*, 1.
No organisms were found in the other samples.

Water Supply of Methuen.

Chemical Examination of Water from the Tubular Wells of the Methuen Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13706	Jan. 23	None.	V. slight.	.01	7.60	.0000	.0048	.26	.0050	.0000	.0632	3.1	.0100
13801	Feb. 11	Slight, clayey.	Cons., clayey.	.05	9.70	.0000	.0024	.26	.0070	.0000	.0800	3.2	.0100
13966	Mar. 11	None.	Slight.	.05	7.50	.0000	.0040	.28	.0070	.0000	.0739	3.2	.0050
14112	Apr. 8	Distinct, clayey.	Slight, clayey.	.02	7.50	.0000	.0012	.28	.0070	.0000	.0616	3.1	.0090
14249	May 6	None.	None.	.03	7.70	.0000	.0018	.31	.0050	.0001	.0539	3.8	.0100
14440	June 10	V. slight.	None.	.07	7.70	.0000	.0020	.22	.0070	.0000	.0889	3.5	.0150
14623	July 15	None.	V. slight.	.07	6.80	.0000	.0024	.24	.0100	.0000	.1248	3.1	.0120
14808	Aug. 12	None.	V. slight.	.04	6.80	.0000	.0028	.23	.0080	.0000	.1326	3.2	.0180
15111	Sept. 9	Slight.	Slight, clayey.	.15	7.10	.0006	.0038	.27	.0050	.0002	.1560	3.1	.0280
15347	Oct. 9	None.	None.	.03	6.90	.0000	.0044	.30	.0030	.0000	.0780	3.0	.0050
15522	Nov. 12	None.	None.	.10	6.80	0000	.0038	.26	.0080	.0000	.0796	2.9	.0300
15705	Dec. 10	None.	None.	.05	7.20	.0000	.0026	.26	.0030	.0000	.0780	2.7	.0080
Av.	....	....	....	.06	7.44	.0001	.0030	.26	.0062	.0000	.0892	3.2	.0133

Odor, faint or none. —— Nos. 13706, 13966, 14249, 14440, 15111, 15522 and 15705 were collected from a faucet at the pumping station; the remaining samples, from a faucet near the pumping station.

Microscopical Examination.

An insignificant number of organisms was found in these samples.

METHUEN.

Chemical Examination of Water from the Covered Reservoir of the Methuen Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13707	Jan. 23	None.	None.	.02	7.90	.0000	.0024	.23	.0030	.0000	.0513	3.1	.0120
13802	Feb. 12	V. slight.	V. slight.	.10	8.40	.0000	.0044	.30	.0030	.0000	.0560	3.4	.0100
13967	Mar. 12	None.	Cons., white.	.08	8.70	.0004	.0040	.26	.0050	.0000	.0847	3.5	.0070
14113	Apr. 8	V. slight.	V. slight.	.02	7.60	.0000	.0010	.27	.0050	.0000	.0616	3.1	.0110
14250	May 6	V. slight.	V. slight.	.04	7.90	.0000	.0018	.27	.0070	.0000	.0500	3.8	.0100
14441	June 10	None.	None.	.07	7.20	.0000	.0022	.24	.0050	.0000	.0760	3.2	.0180
14624	July 15	None.	V. slight.	.08	7.50	.0000	.0028	.24	.0070	.0000	.0975	2.9	.0080
14809	Aug. 12	None.	V. slight.	.04	7.70	.0004	.0026	.26	.0040	.0001	.0936	4.9	.0120
15112	Sept. 9	None.	None.	.05	7.20	.0000	.0022	.26	.0050	.0000	.1443	3.1	.0070
15348	Oct. 9	Distinct, milky.	V. slight.	.20	7.20	.0000	.0028	.29	.0070	.0000	.1092	2.7	.0400
15523	Nov. 11	None.	None.	.08	7.40	.0000	.0034	.28	.0070	.0000	.0608	2.9	.0140
15706	Dec. 10	Slight.	V. slight.	.12	9.70	.0004	.0036	.22	.0030	.0001	.0952	2.6	.0280
Av.	....	....	....	.07	7.87	.0001	.0028	.26	.0051	.0000	.0817	3.3	.0147

Odor, none, except in March, when it was faintly unpleasant, and in May, when it was very faintly vegetable.——Nos. 14441, 15112, 15523 and 15706 were collected from the reservoir, and the others from a faucet near the reservoir.

Microscopical Examination.

An insignificant number of organisms was found in these samples.

Chemical Examination of Water from a Faucet in Methuen supplied from the Methuen Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14859	Aug. 19	Distinct, milky.	Slight.	1.30	8.00	.0000	.0032	.22	.0030	.0000	.1248	3.2	.4000

Odor, decidedly tarry and unpleasant.——The faucet from which the sample was collected is near the end of a 6-inch pipe.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

WATER SUPPLY OF MIDDLEBOROUGH FIRE DISTRICT — MIDDLEBOROUGH.

Chemical Examination of Water from the Well of the Middleborough Fire District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13612	Jan. 7	None.	None.	.03	7.30	.0000	.0012	.82	.1300	.0000	.0429	2.9	.0070
13773	Feb. 6	None.	None.	.00	7.40	.0006	.0028	.81	.1050	.0000	.0316	3.0	.0070
13939	Mar. 6	None.	None.	.00	7.70	.0000	.0008	.78	.0980	.0000	.0462	2.5	.0050
14093	April 3	None.	None.	.00	7.10	.0000	.0014	.78	.1000	.0000	.0462	3.1	.0060
14258	May 7	None.	None.	.05	7.70	.0000	.0024	.85	.1100	.0000	.0385	2.5	.0090
14421	June 5	None.	None.	.04	7.40	.0000	.0030	.75	.0320	.0000	.1140	2.3	.0160
14603	July 10	None.	None.	.08	5.90	.0000	.0054	.68	.0280	.0001	.1343	2.3	.0100
14784	Aug. 7	None.	V. slight.	.13	6.10	.0000	.0040	.68	.0500	.0001	.1404	3.0	.0420
14979	Sept. 4	None.	None.	.15	6.50	.0000	.0046	.65	.0300	.0001	.1347	2.2	.0420
15321	Oct. 7	None.	V. slight.	.12	5.80	.0002	.0028	.66	.0280	.0000	.1186	2.3	.0420
15485	Nov. 6	None.	None.	.08	5.60	.0000	.0022	.70	.0520	.0000	.0819	2.1	.0230
15679	Dec. 4	None.	V. slight.	.07	6.40	.0000	.0032	.73	.0620	.0000	.0741	2.6	.0160
Av.	....	....	....	.06	6.74	.0001	.0028	.74	.0687	.0000	.0836	2.6	.0187

Averages by Years.

-	1887*	-	-	.00	8.39	.0004	.0019	.96	.1519	-	-	-	-
-	1888	-	-	.00	8.67	.0001	.0025	.96	.1494	.0001	-	-	-
-	1889†	-	-	.00	8.77	.0002	.0024	.98	.1770	.0001	-	-	-
-	1893‡	-	-	.05	6.53	.0006	.0024	.73	.0775	.0001	.0840	2.6	.0070
-	1894*	-	-	.09	6.16	.0004	.0032	.69	.0572	.0001	.0804	2.3	.0237
-	1895	-	-	.06	6.74	.0001	.0028	.74	.0687	.0000	.0836	2.6	.0187

* June to December. † January to May. ‡ April and September.

NOTE to analyses of 1895: Odor, none, except in July, when it was very faintly vegetable and unpleasant. The odor of the October sample was faintly vegetable on heating. —— The samples were collected from a faucet at the pumping station while pumping.

Microscopical Examination.

Crenothrix was the only organism found in any of the samples, the largest number in any one sample being 242 in November.

WATER SUPPLY OF MILFORD. — MILFORD WATER COMPANY.

In 1895 a filter was constructed near the pumping station, for the filtration of that portion of the water supply which is drawn directly from the Charles River. The filter has an area of about a quarter of an acre and consists of five feet in depth of sand taken from a bank in the immediate vicinity. Before being applied to the filter the water from the river is passed through a small settling basin. During the summer of 1895 it is said that about 400,000 gallons of water were filtered daily, and that the filter was cleaned about once in six weeks when running at this rate.

MILLBURY.

WATER SUPPLY OF MILLBURY. — MILLBURY WATER COMPANY.

Population in 1895, 5,222. The works are owned by the Millbury Water Company, and water was first introduced Nov. 16, 1895. The source of supply is a large well located near the Millbury branch of the Boston & Albany Railroad, about half a mile north of the village.

The well is built of stone masonry, and is 20 feet in diameter and 40 feet deep. Water is pumped from the well into the mains, and to a distributing reservoir about two miles distant.

The distributing reservoir is circular in shape, 135 feet in diameter, 15 feet deep, and has a capacity of about 1,500,000 gallons. It is built of stone, lined with cement, and is covered with a wooden roof.

The advice of the State Board of Health to the Millbury Water Company, with reference to the use of water from this source as a public water supply, may be found on page 35 of the annual report for 1892.

WATER SUPPLY OF MILLIS.

The town of Millis purchased the works of the Millis Water Company in 1894 and took possession of them on Jan. 1, 1895.

Chemical Examination of Water from the Aqua Rex Spring, Millis.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
15426	**1895.** Oct. 24	None.	None.	.00	5.90	.0000	.0026	.42	.1050	.0000	.0328	2.1	.0010

Odor, none. —— The sample was collected from the reservoir.

Microscopical Examination.

Fungi, *Molds*, 1.

WATER SUPPLY OF MILTON. — MILTON WATER COMPANY.

The water supplied by this company to the town is purchased from the Hyde Park Water Company. Analyses of the water may be found on pages 183–186.

Water Supply of Monson.

Population in 1895, 3,746. The works are owned by the town and were completed in the spring of 1895. The source of supply is a large well in the valley of Ingalls Brook near its junction with Conant Brook, about 2½ miles from the village, in the westerly part of the town. The well is 73 feet in diameter at the top and 23 feet deep, and is lined with stone laid without mortar. The surface of the ground in the vicinity of the well is over 300 feet above the level of the village, and water flows directly from the well into the distributing system, by gravity.

The advice of the State Board of Health to the town of Monson relative to the use of water from this source may be found on pages 29 and 30 of the annual report for 1894.

Montague.

The advice of the State Board of Health to a water supply committee of the village of Miller's Falls, relative to the introduction of a public water supply for the village of Miller's Falls in the towns of Montague and Erving and the village known as Lake Pleasant in Montague, by extending the pipes of the Turner's Falls water works, may be found on page 37 of this report.

An analysis of a sample of water from Green Pond, Montague, collected in connection with this investigation, is given below.

Chemical Examination of Water from Green Pond, Montague.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
13869	1895. Feb. 20	V. slight.	Slight.	.03	1.20	0.70	.0230	.0226	.0204	.0022	.14	.0000	.0000	.1755	1.9

Odor, distinctly vegetable. —— The sample was collected from the pond, near the middle.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 5.

The advice of the State Board of Health to W. H. Nims and others of the village of Montague Center, relative to the use of the

MONTAGUE.

water of certain springs as a source of public water supply for the village, may be found on pages 37 and 38 of this volume. An analysis of a sample of water collected from a brook flowing from the springs is given below.

Chemical Examination of Water from a Brook near Montague Center.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
13823	1895. Feb. 14	None.	Slight.	.02	3.70	.0000	.0016	.10	.0200	.0000	.0360	1.8	.0000

Odor, none.—— The sample was collected from a brook flowing from springs just above the Leverett Road, a short distance south of the village of Montague Center.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

Near the end of the year an application was received from a water supply committee of the village of Miller's Falls in Montague, for advice relative to the use of Osgood Brook in Montague and Wendell as a source of public water supply. Analyses of samples of water collected from this source are given below.

Chemical Examination of Water from Ruggles Pond and Osgood Brook in Wendell and Montague.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
15690	1895. Dec. 8	None.	V. slight.	.88	3.00	1.30	.0006	.0102	.0092	.0010	.08	.0020	.0000	.7644	0.5
15780	Dec. 19	V. slight.	V. slight.	.70	2.90	1.20	.0004	.0118	.0102	.0016	.06	.0030	.0000	.6391	0.2
15689	Dec. 8	None.	Slight.	.85	2.75	1.25	.0004	.0092	.0086	.0006	.08	.0000	.0000	.7566	0.3
15779	Dec. 19	None.	V. slight.	.37	2.65	0.80	.0004	.0084	.0064	.0020	.07	.0000	.0000	.4081	0.3

Odor of the first sample, distinctly mouldy; of the second, distinctly vegetable and mouldy; of the third, none, becoming faintly vegetable on heating; of the last sample, faintly vegetable.—— The first two samples were collected from Ruggles Pond at its outlet; the last two, from Osgood Brook at Lyon's Mill, a little over a mile below Ruggles Pond.

Microscopical Examination.

An insignificant number of organisms was found in these samples.

MONTAGUE.

WATER SUPPLY OF TURNER'S FALLS FIRE DISTRICT — MONTAGUE.

Chemical Examination of Water from Lake Pleasant, Montague.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13592	Jan. 2	Slight.	Slight.	.06	2.25	0.80	.0044	.0088	.0078	.0010	.12	.0020	.0000	.0924	0.8
13770	Feb. 5	None.	V. slight.	.08	2.35	0.75	.0082	.0096	.0080	.0016	.10	.0090	.0000	.1145	0.5
13941	Mar. 5	None.	V. slight.	.01	2.15	0.45	.0032	.0090	.0074	.0016	.12	.0070	.0000	.1039	0.5
14085	Apr. 2	None.	V. slight.	.02	2.55	0.75	.0000	.0072	.0054	.0018	.10	.0080	.0000	.0816	0.8
14586	July 8	Slight.	Slight, white.	.04	2.30	0.50	.0000	.0110	.0104	.0006	.15	.0030	.0000	.1185	0.5
14812	Aug. 12	None.	V. slight.	.02	2.35	0.75	.0000	.0070	.0054	.0016	.18	.0030	.0000	.1560	0.8
15541	Nov. 13	V. slight.	V. slight.	.12	2.30	1.05	.0006	.0140	.0066	.0074	.15	.0070	.0000	.1248	0.3
Av.	....	....	....	.05	2.32	0.72	.0023	.0095	.0073	.0022	.13	.0056	.0000	.1131	0.6

Averages by Years.

-	1887*	-	-	.03	2.74	0.81	.0018	.0116	-	-	.10	.0007	-	-	-
-	1888	-	-	.00	2.33	0.49	.0027	.0071	-	-	.09	.0085	.0000	-	-
-	1889†	-	-	.01	2.19	0.40	.0008	.0063	.0052	.0011	.09	.0088	.0000	-	-
-	1893	-	-	.04	2.28	0.68	.0023	.0115	.0083	.0032	.12	.0045	.0000	.1137	0.6
-	1894	-	-	.04	2.13	0.68	.0022	.0097	.0076	.0021	.12	.0025	.0000	.1071	0.4
-	1895	-	-	.05	2.32	0.72	.0023	.0095	.0073	.0022	.13	.0056	.0000	.1131	0.6

* June to December. † January to June.

NOTE to analyses of 1895: Odor in January, distinctly vegetable; in February, very faintly vegetable, becoming stronger and also unpleasant on heating; in July, decidedly unpleasant; no odor was detected in the remaining samples. —— The samples were collected from faucets in the village.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 20.

WATER SUPPLY OF NAHANT.

(See *Swampscott.*)

NANTUCKET.

WATER SUPPLY OF NANTUCKET. — WANNACOMET WATER COMPANY.

Chemical Examination of Water from Wannacomet Pond, Nantucket.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13603	Jan. 3	V. slight.	Slight.	.05	6.60	1.60	.0002	.0270	.0238	.0032	2.26	.0000	.0000	.1155	1.9
13851	Feb. 5	Slight.	Slight.	.12	6.30	1.05	.0014	.0090	.0068	.0022	2.13	.0030	.0000	.0858	1.4
13940	Mar. 5	V. slight.	V. slight.	.01	6.55	1.10	.0008	.0120	.0092	.0028	1.90	.0030	.0000	.1016	1.6
14096	Apr. 2	V. slight.	V. slight.	.02	6.40	1.90	.0006	.0096	.0090	.0006	2.12	.0020	.0000	.1193	1.9
14257	May 6	V. slight.	Slight.	.05	6.45	1.65	.0006	.0096	.0080	.0016	2.00	.0000	.0000	.0808	1.4
14423	June 4	Distinct.	Slight.	.02	6.20	1.25	.0014	.0172	.0142	.0030	2.00	.0030	.0000	.1315	1.6
14600	July 9	Distinct.	Slight, rusty.	.03	6.65	1.90	.0012	.0138	.0108	.0030	2.30	.0030	.0000	.1580	1.7
14714	July 24	Distinct.	Slight.	.07	6.25	1.65	.0008	.0158	.0122	.0036	2.80	.0030	.0000	.1925	1.9
14778	Aug. 6	Slight.	Slight.	.07	6.45	1.75	.0000	.0156	.0114	.0042	2.00	.0080	.0000	.1716	2.2
14901	Aug. 21	Slight.	Slight, yellow.	.08	6.60	1.60	.0010	.0158	.0134	.0024	2.06	.0000	.0000	.1950	1.5
14971	Sept. 3	Slight, milky.	Slight, yellow.	.15	6.25	1.25	.0000	.0182	.0160	.0022	2.35	.0000	.0001	.2887	1.4
15219	Sept. 18	V. slight, milky.	V. slight.	.15	6.70	1.25	.0000	.0150	.0126	.0024	2.20	.0000	.0000	.1521	1.6
15324	Oct. 7	V. slight.	V. slight.	.05	6.45	1.70	.0008	.0158	.0128	.0030	2.40	.0030	.0000	.1466	1.7
15411	Oct. 21	V. slight.	V. slight.	.08	6.35	1.90	.0012	.0130	.0108	.0022	2.05	.0070	.0000	.1420	1.7
15484	Nov. 5	Slight.	Slight.	.10	6.55	1.95	.0016	.0136	.0104	.0032	2.10	.0030	.0000	.2012	1.4
15676	Dec. 3	Slight, green.	V. slight.	.08	6.05	1.85	.0000	.0154	.0108	.0046	2.16	.0030	.0000	.1287	1.4
Av*	....	....	....	.06	6.41	1.57	.0008	.0146	.0119	.0027	2.14	.0024	.0000	.1406	1.6

Averages by Years.

-	1887†	-	-	.08	6.72	1.20	.0002	.0175	-	-	2.20	.0020	-	-	-
-	1888‡	-	-	.05	5.98	0.98	.0002	.0153	-	-	2.11	.0048	.0002	-	-
-	1889§	-	-	.10	-	-	.0031	.0416	.0269	.0147	1.99	.0035	.0001	-	-
-	1890‖	-	-	.00	-	-	.0006	.0188	.0127	.0061	1.95	.0025	.0000	-	-
-	1891¶	-	-	.22	7.54	2.33	.0112	.0588	.0317	.0271	1.86	.0076	.0001	-	1.4
-	1892**	-	-	.03	6.84	1.68	.0004	.0136	.0111	.0025	2.22	.0033	.0000	-	1.6
-	1893¶	-	-	.22	7.00	2.02	.0013	.0469	.0208	.0261	2.08	.0025	.0000	.2167	1.6
-	1894††	-	-	.05	6.74	1.65	.0015	.0131	.0108	.0023	2.30	.0000	.0000	.1227	1.6
-	1895	-	-	.06	6.41	1.57	.0008	.0146	.0119	.0027	2.14	.0024	.0000	.1406	1.6

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

† July to November. ‡ February to May. § September to November.
‖ March and April. ¶ August to December. ** May to October.
†† June to December.

NOTE to analyses of 1895: Odor, generally faintly vegetable, sometimes stronger and also unpleasant; rarely none. —— The samples were collected as follows: Nos. 13603, 13940, 14257, 14423, 14600, 14714, 15324 and 15484, from the pond; Nos. 13851, 14096 and 15219, from the distributing tank; Nos. 14778 and 14971, from the main while pumping; Nos. 14901 and 15411, from a faucet in the pumping station; No. 15676, from the pump well.

NANTUCKET.

Microscopical Examination of Water from Wannacomet Pond, Nantucket.

[Number of organisms per cubic centimeter.]

	1895.							
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.
Day of examination,	5	20	8	6	8	7	11	27
Number of sample,	13603	13851	13940	14096	14257	14423	14600	14714
PLANTS.								
Diatomaceæ,	200	64	180	35	54	49	3	7
Cyclotella,	0	0	0	1	0	3	0	0
Navicula,	0	0	0	0	2	2	2	0
Synedra,	200	64	180	34	52	44	1	2
Tabellaria,	0	0	0	0	0	pr.	0	5
Cyanophyceæ, Anabæna,	0	0	0	0	0	0	15	59
Algæ,	0	0	0	0	2	2	6	0
Chlorococcus,	0	0	0	0	0	0	0	0
Protococcus,	0	0	0	0	2	2	6	0
Scenedesmus,	0	0	0	0	0	pr.	pr.	0
Zoöspores,	0	0	0	0	0	0	0	0
Fungi, Crenothrix,	0	3	0	0	pr.	3	0	0
ANIMALS.								
Infusoria,	123	pr.	77	76	468	215	150	0
Ceratium,	0	0	0	0	0	5	0	0
Dinobryon,	0	0	48	32	0	62	150	0
Dinobryon cases,	122	0	28	44	464	148	0	0
Peridinium,	1	0	1	0	4	0	pr.	0
Trachelomonas,	pr.	pr.	0	0	0	0	0	0
Vermes,	0	0	1	1	3	pr.	0	0
Anurea,	0	0	0	0	3	pr.	0	0
Polyarthra,	0	0	1	1	pr.	0	0	0
Miscellaneous, Zoöglœa,	0	8	0	0	0	0	0	0
TOTAL,	323	75	258	112	527	269	174	66

NANTUCKET.

Microscopical Examination of Water from Wannacomet Pond, Nantucket — Concluded.

[Number of organisms per cubic centimeter.]

	1895.							
	Aug.	Aug.	Sept.	Sept.	Oct.	Oct.	Nov.	Dec.
Day of examination,	8	23	6	21	9	24	7	5
Number of sample,	14778	14901	14971	15219	15324	15411	15484	15676
PLANTS.								
Diatomaceæ,	11	23	6	4	1	1	2	185
Cyclotella,	0	14	0	0	0	0	0	0
Navicula,	1	0	0	0	1	0	0	1
Synedra,	6	9	6	3	0	1	2	184
Tabellaria,	4	0	0	1	0	0	0	0
Cyanophyceæ, Anabæna,	0	0	0	0	3	0	0	0
Algæ,	0	59	0	0	0	0	0	11
Chlorococcus,	0	34	0	0	0	0	0	0
Protococcus,	0	1	0	0	0	0	0	11
Scenedesmus,	0	7	0	0	0	0	0	0
Zoöspores,	0	17	0	0	0	0	0	0
Fungi, Crenothrix,	0	2	60	20	0	0	0	0
ANIMALS.								
Infusoria,	0	38	1	2	6	111	761	1,398
Ceratium,	0	0	0	2	6	0	0	0
Dinobryon,	0	0	0	0	0	7	504	1,376
Dinobryon cases,	0	0	0	0	0	104	256	0
Peridinium,	0	37	0	0	0	0	1	21
Trachelomonas,	0	1	1	0	0	0	0	1
Vermes,	0	1	0	1	0	4	2	5
Anurea,	0	0	0	1	0	4	2	5
Polyarthra,	0	1	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	112	0	0	0	3	20	0
TOTAL,	11	235	67	27	10	119	785	1,599

Water Supply of Natick.

Chemical Examination of Water from Dug Pond, Natick.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13595	Jan. 2	V. slight.	V. slight.	.05	5.20	1.15	.0184	.0188	.0170	.0018	.83	.0050	.0000	.2079	2.6
13768	Feb. 4	Slight.	Slight.	.15	6.50	1.40	.0054	.0160	.0146	.0014	.90	.0550	.0003	.2133	2.6
13925	Mar. 5	Decided.	Cons., earthy.	.15	6.45	2.10	.0034	.0166	.0146	.0020	.88	.0370	.0000	.3041	2.5
14070	Apr. 1	Slight.	Cons., white.	.18	7.00	2.15	.0034	.0156	.0142	.0014	.90	.0780	.0002	.1910	2.6
14228	May 1	V. slight.	Slight.	.12	6.50	2.10	.0010	.0160	.0132	.0028	.86	.0600	.0002	.2040	2.7
14415	June 3	Slight.	Slight.	.10	6.55	2.15	.0016	.0172	.0132	.0040	.88	.0480	.0000	.2546	2.5
14572	July 1	Distinct.	Cons.	.12	6.70	1.75	.0014	.0202	.0162	.0040	.90	.0280	.0000	.2464	3.6
14754	Aug. 1	Slight.	Slight.	.10	6.35	2.15	.0006	.0216	.0174	.0042	.88	.0100	.0001	.2652	3.0
14977	Sept. 3	Distinct.	Slight.	.08	6.35	1.80	.0006	.0250	.0208	.0042	.90	.0000	.0003	.2526	2.7
15301	Oct. 1	Slight.	Slight.	.10	6.00	1.75	.0006	.0222	.0192	.0030	.84	.0030	.0000	.1934	2.1
15473	Nov. 4	Distinct.	Cons., green.	.18	5.85	1.85	.0128	.0226	.0198	.0028	.84	.0150	.0003	.3159	2.3
15658	Dec. 2	Distinct.	Slight.	.23	5.85	2.00	.0040	.0172	.0160	.0012	.86	.0350	.0000	.2808	2.6
Av.	....	....	....	.13	6.27	1.86	.0044	.0191	.0164	.0027	.87	.0312	.0001	.2441	2.6

Averages by Years.

-	1887*	-	-	.14	5.25	1.21	.0039	.0215	-	-	.70	.0050	-	-	-
-	1888	-	-	.13	5.24	1.09	.0070	.0228	-	-	.66	.0197	.0003	-	-
-	1889	-	-	.16	5.51	1.22	.0044	.0242	.0196	.0046	.71	.0289	.0004	-	-
-	1890	-	-	.14	5.85	1.36	.0027	.0199	.0166	.0033	.72	.0227	.0002	-	2.7
-	1891	-	-	.09	5.71	1.45	.0085	.0207	.0167	.0040	.69	.0326	.0003	-	2.4
-	1892	-	-	.06	5.38	1.24	.0068	.0173	.0135	.0038	.72	.0323	.0001	-	2.4
-	1893	-	-	.08	5.28	1.39	.0062	.0192	.0158	.0034	.71	.0193	.0003	.2345	2.1
-	1894	-	-	.10	5.64	1.65	.0060	.0155	.0132	.0023	.80	.0218	.0001	.2124	2.3
-	1895	-	-	.13	6.27	1.86	.0044	.0191	.0164	.0027	.87	.0312	.0001	.2441	2.6

* June to December.

Note to analyses of 1895: Odor, generally vegetable, frequently mouldy or unpleasant. —— The samples were collected from a faucet at the pumping station.

NATICK.

Microscopical Examination of Water from Dug Pond, Natick

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	4	7	7	3	2	5	3	3	6	3	6	3
Number of sample,	13595	13768	13925	14070	14228	14415	14572	14754	14977	15301	15473	15658
PLANTS.												
Diatomaceæ,	**153**	**5**	**32**	**12**	**540**	**344**	**33**	**46**	**28**	**47**	**1,680**	**476**
Asterionella,	124	0	4	1	140	0	0	0	0	3	3	56
Cyclotella,	28	1	2	0	100	226	3	1	5	0	2	40
Fragilaria,	0	0	0	0	4	2	0	1	0	0	0	0
Melosira,	1	0	26	3	216	27	23	39	21	42	1,660	380
Meridion,	0	2	0	4	0	0	0	0	0	0	0	0
Synedra,	pr.	2	0	4	76	50	2	5	2	0	15	0
Tabellaria,	0	0	0	0	4	39	5	0	0	2	0	0
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**96**	**241**	**152**	**0**	**0**
Chroöcoccus,	0	0	0	0	0	1	0	0	0	16	0	0
Clathrocystis,	0	0	0	0	0	0	0	24	9	0	0	0
Microcystis,	0	0	0	0	0	0	2	72	232	136	0	0
Algæ,	**0**	**0**	**0**	**0**	**0**	**25**	**146**	**220**	**94**	**23**	**1**	**30**
Chlorococcus,	0	0	0	0	0	0	0	0	13	0	0	0
Cœlastrum,	0	0	0	0	0	0	0	0	0	0	0	28
Protococcus,	0	0	0	0	0	10	143	212	81	23	0	0
Raphidium,	0	0	0	0	0	15	3	0	0	0	1	2
Staurogenia,	0	0	0	0	0	0	0	8	0	0	0	0
Fungi, Crenothrix,	**0**	**1**	**2**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**32**	**0**
ANIMALS.												
Infusoria,	**3**	**1**	**2**	**2**	**76**	**147**	**5**	**0**	**2**	**1**	**276**	**111**
Ceratium,	0	0	0	0	0	0	0	0	2	0	0	0
Dinobryon,	0	0	0	0	0	12	0	0	0	0	196	22
Dinobryon cases,	3	0	0	0	76	135	0	0	0	1	80	88
Peridinium,	0	1	0	2	0	0	0	0	0	0	0	0
Trachelomonas,	pr.	0	2	0	0	0	5	0	0	0	0	1
Vermes,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**1**	**0**
Anurea,	0	0	0	0	0	0	0	2	0	0	1	0
Rotatorian ova,	0	0	0	0	0	0	0	0	2	0	0	0
TOTAL,	156	7	36	14	616	517	190	365	367	223	1,990	617

NATICK.

Table showing Heights of Water in Dug Pond on the First of Each Month in 1895.

NOTE. — High-water mark is 13.0 feet.

1895.	Height of Water.	1895.	Height of Water.
	Feet.		Feet.
Jan. 1, ...	8.63	July 1, ...	10.92
Feb. 1, ...	10.00	Aug. 1, ...	9.83
March 1, ...	9.67	Sept. 1, ...	8.75
April 1, ...	12.92	Oct. 1, ...	8.00
May 1, ...	13.33	Nov. 1, ...	9.25
June 1, ...	12.17	Dec. 1, ...	12.50

WATER SUPPLY OF NEEDHAM.

Chemical Examination of Water from the Needham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14213	Apr. 24	None.	None.	.00	6.70	.0000	.0012	.87	.1500	.0000	.0079	1.9	.0000
15414	Oct. 23	None.	None.	.00	5.70	.0000	.0000	.68	.1100	.0000	.0250	1.8	.0000

Averages by Years.

-	1891*	-	-	.00	6.10	.0022	.0022	.72	.1500	.0000	-	1.7	-
-	1892†	-	-	.00	6.12	.0000	.0001	.65	.1400	.0000	-	2.1	.0072
-	1893	-	-	.00	5.28	.0000	.0007	.63	.1230	.0000	.0522	1.9	.0000
-	1894	-	-	.01	5.18	.0013	.0005	.66	.1367	.0000	.0147	1.7	.0020
-	1895‡	-	-	.00	6.20	.0000	.0006	.78	.1300	.0000	.0165	1.8	.0000

* November. † July and August. ‡ April and October.

NOTE to analyses of 1895: Odor, none. —— The first sample was collected from a faucet at a drinking fountain and the second from a faucet at the pumping station.

Microscopical Examination.

No. 14213. No organisms.
No. 15414. Fungi, *Molds*, 3.

NEW BEDFORD.

Water Supply of New Bedford.

Chemical Examination of Water from the Conduit of the New Bedford Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13694	Jan. 21	V. slight.	V. slight.	1.50	5.75	2.50	.0022	.0228	.0182	.0046	.55	.0050	.0000	2.2340	1.4
13880	Feb. 25	V. slight.	Cons., brown.	1.20	5.40	1.90	.0020	.0200	.0192	.0008	.63	.0070	.0000	1.0625	1.3
14035	Mar. 25	V. slight.	Slight.	0.80	4.10	1.40	.0002	.0136	.0114	.0022	.52	.0070	.0000	0.7199	1.3
14195	Apr. 22	V. slight.	Cons., brown.	1.05	4.55	2.40	.0004	.0194	.0180	.0014	.53	.0070	.0000	0.9756	1.1
14370	May 27	V. slight.	Slight.	1.35	5.20	3.00	.0008	.0246	.0212	.0034	.52	.0050	.0000	1.2882	0.9
14537	June 25	V. slight.	Slight, rusty.	1.60	5.05	2.85	.0012	.0292	.0270	.0022	.52	.0030	.0000	1.2320	0.9
14725	July 29	Slight.	Cons.	1.10	4.55	2.55	.0000	.0262	.0238	.0024	.58	.0100	.0000	0.9856	1.3
14988	Sept. 4	Slight.	Slight.	0.75	4.10	1.90	.0006	.0214	.0192	.0022	.51	.0020	.0001	0.6891	0.6
15231	Sept. 23	V. slight.	Slight.	0.60	3.95	1.75	.0000	.0212	.0184	.0028	.52	.0030	.0000	0.5265	0.9
15434	Oct. 27	V. slight.	V. slight.	0.30	3.50	1.35	.0000	.0208	.0160	.0048	.53	.0050	.0000	0.4602	0.8
15606	Nov. 25	V. slight.	V. slight.	0.62	4.35	1.95	.0008	.0206	.0194	.0012	.48	.0050	.0001	0.6864	1.1
15793	Dec. 23	None.	V. slight.	1.20	6.15	2.95	.0030	.0262	.0254	.0008	.61	.0050	.0000	1.2397	1.3
Av.	....	....	....	1.01	4.72	2.21	.0009	.0222	.0198	.0024	.54	.0053	.0000	1.0083	1.1

Averages by Years.

-	1887*	-	-	1.37	5.16	1.95	.0021	.0296	-	-	.56	.0137	-	-	-
-	1888	-	-	1.48	5.19	2.32	.0014	.0254	-	-	.53	.0183	.0001	-	-
-	1889	-	-	1.51	3.96	1.74	.0014	.0241	.0206	.0035	.50	.0103	.0001	-	-
-	1890	-	-	1.48	5.01	2.41	.0013	.0232	.0195	.0037	.45	.0125	.0001	-	1.2
-	1891	-	-	0.95	3.90	1.81	.0005	.0197	.0171	.0026	.42	.0103	.0000	-	0.8
-	1892	-	-	1.10	4.87	2.24	.0006	.0227	.0194	.0033	.52	.0108	.0001	-	1.0
-	1893	-	-	1.35	5.05	2.36	.0022	.0224	.0189	.0035	.51	.0051	.0001	1.0440	1.0
-	1894	-	-	1.21	4.80	2.18	.0012	.0194	.0178	.0016	.53	.0058	.0000	0.9882	1.0
-	1895	-	-	1.01	4.72	2.21	.0009	.0222	.0198	.0024	.54	.0053	.0000	1.0083	1.1

* June to December.

Note to analyses of 1895: Odor, distinctly vegetable. —— The samples were collected from the conduit at its entrance to the receiving reservoir, and represent water from the storage reservoir. Water from Little Quittacas Pond was drawn into the storage reservoir from June 24 to July 2, inclusive, and from July 26 to October 7, inclusive.

NEW BEDFORD.

Microscopical Examination of Water from the Conduit of the New Bedford Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Sept.	Sept.	Oct.	Nov.	Dec.
Day of examination,	23	28	27	23	28	26	31	7	25	30	26	24
Number of sample,	13694	13880	14035	14195	14370	14537	14725	14988	15231	15434	15606	15793
PLANTS.												
Diatomaceæ, Synedra,	0	2	1	7	4	4	1	0	0	0	0	0
Cyanophyceæ,	0	0	0	8	0	16	83	81	180	0	0	0
Aphanocapsa,	0	0	0	8	0	0	0	0	0	0	0	0
Merismopedia,	0	0	0	0	0	16	31	81	176	0	0	0
Microcystis,	0	0	0	0	0	0	52	0	4	0	0	0
Algæ,	6	0	0	0	18	10	34	0	13	0	0	0
Chlorococcus,	0	0	0	0	11	0	0	0	0	0	0	0
Protococcus,	6	0	0	0	7	10	34	0	13	0	0	0
Fungi,	0	0	0	6	7	11	6	10	0	6	0	1
Crenothrix,	0	0	0	6	7	11	6	10	0	0	0	1
Molds,	0	0	0	0	0	0	0	0	0	6	0	0
ANIMALS.												
Infusoria,	14	83	10	0	7	0	0	1	0	0	0	0
Dinobryon,	1	39	8	0	0	0	0	0	0	0	0	0
Dinobryon cases,	12	38	0	0	3	0	0	0	0	0	0	0
Peridinium,	1	4	2	0	4	0	0	0	0	0	0	0
Trachelomonas,	0	2	0	0	0	0	0	1	0	0	0	0
Vermes, Anurea,	0	0	0	0	1	1	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	212	32	108	96	108	0	0	0	32	2	0	20
TOTAL,	232	117	119	117	145	42	124	92	225	8	0	21

NEW BEDFORD.

Chemical Examination of Water from Little Quittacas Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14193	Apr. 22	Slight.	Cons., white.	.17	3.15	1.30	.0000	.0142	.0128	.0014	.51	.0000	.0000	.3752	0.8
14987	Sept. 4	Slight.	Slight.	.15	3.15	1.20	.0008	.0196	.0154	.0042	.56	.0080	.0000	.2911	0.8
15821	Dec. 30	V. slight, clayey.	Slight, brown.	.22	3.20	1.25	.0016	.0150	.0130	.0020	.47	.0030	.0000	.2733	0.5
Av.	....	....	....	.18	3.17	1.25	.0008	.0162	.0137	.0025	.51	.0037	.0000	.3132	0.7

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1887*	-	-	.23	2.92	1.16	.0003	.0149	-	-	.51	.0035	-	-	-
-	1888†	-	-	.15	3.00	1.15	.0003	.0171	-	-	.48	.0035	.0001	-	-
-	1893	-	-	.11	3.02	1.23	.0015	.0156	.0128	.0028	.48	.0025	.0000	.2904	0.6
-	1894	-	-	.18	2.91	0.95	.0002	.0165	.0137	.0028	.48	.0008	.0000	.3074	0.7
-	1895	-	-	.18	3.17	1.25	.0008	.0162	.0137	.0025	.51	.0037	.0000	.3132	0.7

* June and September. † January and May.

NOTE to analyses of 1895: Odor, vegetable.—— The samples were collected from the pond.

Microscopical Examination of Water from Little Quittacas Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1895. April.	1895. September.	1896. January.
Day of examination,	23	7	2
Number of sample,	14193	14987	15821
PLANTS.			
Diatomaceæ,	**102**	**6**	**5**
Asterionella,	57	0	0
Cyclotella,	11	3	0
Synedra,	34	3	5
Cyanophyceæ,	**0**	**98**	**0**
Chroöcoccus,	0	9	0
Merismopedia,	0	89	0
Algæ,	**3**	**82**	**0**
Protococcus,	0	82	0
Zoöspores,	3	0	0
ANIMALS.			
Infusoria,	**32**	**1**	**0**
Dinobryon,	22	0	0
Dinobryon cases,	9	0	0
Peridinium,	1	0	0
Trachelomonas,	0	1	0
Crustacea, Cyclops,	**.12**	**0**	**0**
Miscellaneous, Zoöglœa,	**11**	**0**	**20**
TOTAL,	148	187	25

NEW BEDFORD.

Chemical Examination of Water from Great Quittacas Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14192	Apr. 22	V. slight.	Slight.	.63	3.35	1.50	.0002	.0142	.0128	.0014	.51	.0030	.0000	.6912	0.8
14986	Sept. 4	Slight.	Slight.	.30	3.35	1.05	.0000	.0172	.0160	.0012	.55	.0000	.0000	.4635	0.5
15820	Dec. 30	V. slight.	Slight.	.27	3.20	1.10	.0000	.0148	.0112	.0036	.52	.0030	.0000	.4042	0.5
Av.	....	....	....	.40	3.30	1.22	.0001	.0154	.0133	.0021	.53	.0020	.0000	.5196	0.6

Averages by Years.

-	1893*	-	-	.85	3.65	1.92	.0000	.0166	.0144	.0022	.43	.0018	.0000	.7812	0.3
-	1894	-	-	.49	3.30	1.35	.0002	.0154	.0139	.0015	.50	.0017	.0000	.5031	0.6
-	1895	-	-	.40	3.30	1.22	.0001	.0154	.0133	.0021	.53	.0020	.0000	.5196	0.6

* Five samples, July to September.

NOTE to analyses of 1895: Odor of the first two samples, vegetable; of the last sample, disagreeable. —— The samples were collected from the pond.

Microscopical Examination of Water from Great Quittacas Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1895. April.	1895. September.	1896. January.
Day of examination,	23	7	2
Number of sample,	14192	14986	15820
PLANTS.			
Diatomaceæ,	**45**	**29**	**25**
Asterionella,	41	19	14
Cyclotella,	0	3	0
Fragilaria,	0	0	2
Melosira,	0	0	3
Navicula,	0	2	2
Synedra,	4	5	4
Cyanophyceæ, Chroöcoccus,	**0**	**15**	**0**
Algæ,	**6**	**3**	**0**
Chlorococcus,	3	1	0
Conferva,	0	2	0
Zoöspores,	3	0	0
Fungi, Crenothrix,	**0**	**36**	**0**
ANIMALS.			
Infusoria,	**9**	**27**	**3**
Dinobryon cases,	1	0	0
Peridinium,	6	24	3
Phacus,	0	2	0
Tintinnidium,	0	1	0
Trachelomonas,	2	0	0
Miscellaneous, Zoöglœa,	**9**	**0**	**0**
TOTAL,	69	110	28

NEW BEDFORD.

Chemical Examination of Water from Long Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14194	Apr. 22	Slight.	Cons.	1.10	4.10	2.55	.0002	.0212	.0172	.0040	.50	.0000	.0000	1.0625	0.5
14985	Sept. 4	Slight.	Slight.	0.63	3.80	1.90	.0004	.0160	.0148	.0012	.62	.0000	.0001	0.7315	0.4
15819	Dec. 30	Distinct.	Slight.	0.93	4.30	2.30	.0000	.0200	.0182	.0018	.48	.0030	.0000	1.0433	0.6
Av.	....	....	....	0.89	4.07	2.25	.0002	.0190	.0167	.0023	.53	.0010	.0000	0.9458	0.5

Averages by Years.

-	1891*	-	-	0.55	3.15	1.62	.0000	.0130	.0114	.0016	.49	.0020	.0000	-	0.3
-	1893†	-	-	0.85	3.65	1.92	.0000	.0166	.0144	.0022	.43	.0018	.0000	.7812	0.3
-	1894	-	-	1.00	3.80	1.94	.0002	.0183	.0162	.0021	.47	.0013	.0000	.9025	0.5
-	1895	-	-	0.89	4.07	2.25	.0002	.0190	.0167	.0023	.53	.0010	.0000	.9458	0.5

* December, two samples. † July to September, five samples.

NOTE to analyses of 1895: Odor, vegetable; of the last sample, also mouldy.——The samples were collected from the pond.

Microscopical Examination.

The total number of organisms per cubic centimeter found in these samples was as follows: No. 14194, 260; No. 14985, 5; No. 15819, 69.

Table showing Heights of Water in Acushnet Reservoir and Little Quittacas Pond on the First of Each Month in 1895.

1895.	Acushnet Reservoir. Distance below High-water Mark.	Little Quittacas Pond. Distance below High-water Mark.	1895.	Acushnet Reservoir. Distance below High-water Mark.	Little Quittacas Pond. Distance below High-water Mark.
	Feet.	Feet.		Feet.	Feet.
Jan. 1, ...	0.00	2.67	July 1, ...	0.17	1.33
Feb. 1, ...	0.00	1.75	Aug. 1, ...	0.58	1.50
March 1, ...	0.00	1.42	Sept. 1, ...	0.67	3.00
April 1, ...	0.00	1.08	Oct. 1, ...	0.67	4.67
May 1, ...	0.00	1.00	Nov. 1, ...	0.75	4.00
June 1, ...	0.00	0.92	Dec. 1, ...	0.25	3.42

Water Supply of Newburyport.

The works of the Newburyport Water Company were taken by the city Feb. 1, 1895.

Chemical Examination of Water from a Faucet in Newburyport, supplied from the Newburyport Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13667	Jan. 15	V. slight.	V. slight.	.20	6.40	.0002	.0028	0.45	.0180	.0000	.0869	2.5	.0260
13847	Feb. 19	Slight.	Slight.	.25	5.60	.0008	.0020	0.44	.0150	.0000	.0780	2.2	.0620
14003	Mar. 19	V. slight, milky.	V. slight.	.15	5.30	.0000	.0044	0.40	.0120	.0000	.1185	2.3	.0150
14152	Apr. 16	Slight, milky.	V. slight.	.12	4.90	.0000	.0030	0.42	.0150	.0000	.1359	2.4	.0150
14328	May 20	Slight, milky.	Slight.	.15	5.10	.0000	.0024	0.42	.0220	.0000	.0806	2.3	.0300
14499	June 19	Slight, milky.	V. slight.	.20	5.90	.0010	.0070	1.91	.0080	.0000	.1092	2.2	.0350
14683	July 23	Distinct, milky.	None.	.20	6.00	.0000	.0040	0.55	.0180	.0000	.0937	3.0	.0250
14874	Aug. 20	Slight, milky.	V. slight.	.08	6.50	.0000	.0020	0.46	.0200	.0000	.0468	2.3	.0250
15186	Sept. 17	Slight.	Slight.	.18	6.50	.0004	.0046	0.80	.0150	.0000	.0998	2.3	.0280
15368	Oct. 15	Distinct, milky.	Slight, floc.	.32	6.80	.0000	.0118	0.51	.0150	.0001	.3315	2.3	.0530
15569	Nov. 19	Slight, milky.	Slight.	.20	6.00	.0000	.0064	0.48	.0150	.0000	.2223	2.6	.0220
15755	Dec. 17	Distinct.	V. slight.	.13	6.50	.0000	.0036	0.46	.0180	.0000	.1808	2.3	.0260
Av.	....	....	....	.18	5.96	.0002	.0045	0.61	.0159	.0000	.1320	2.4	.0302

Averages by Years.

-	1887-88*	-	-	.03	5.39	.0004	.0032	0.45	.0312	.0001	-	-	-
-	1893†	-	-	.11	8.50	.0013	.0048	3.44†	.0178	.0000	.1391	2.7	.0164
-	1894	-	-	.13	6.00	.0001	.0039	0.46	.0133	.0000	.0860	2.3	.0308
-	1895	-	-	.18	5.96	.0002	.0045	0.61	.0159	.0000	.1320	2.4	.0302

* June, 1887, to May, 1888.

† The very high chlorine present in the water in 1893 was due to the use at times of water from the Merrimack River which contained a small amount of sea water.

Note to analyses of 1895: Odor in May and October, vegetable; at other times, none. In January, February, March, April and September a vegetable odor was developed on heating.—— The samples were collected from a faucet at No. 2 State Street.

Microscopical Examination.

An insignificant number of organisms was found in these samples.

NEWTON.

WATER SUPPLY OF NEWTON.

Chemical Examination of Water from a Faucet at the Newton Water Works Pumping Station.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13648	Jan. 14	None.	None.	.00	5.80	.0000	.0052	.44	.0200	.0000	.0513	2.9	.0030
13839	Feb. 19	None.	Slight.	.00	5.80	.0000	.0014	.39	.0200	.0000	.0312	2.5	.0170
13988	Mar. 18	V. slight.	Slight.	.05	6.20	.0000	.0012	.41	.0200	.0000	.0355	2.5	.0300
14162	Apr. 17	Slight, milky.	Slight.	.04	5.40	.0000	.0016	.41	.0220	.0000	.0908	2.6	.0280
14331	May 21	V. slight.	V. slight.	.03	5.70	.0000	.0002	.36	.0230	.0000	.0395	2.2	.0100
14506	June 20	V. slight.	Slight, earthy.	.05	6.70	.0000	.0018	.36	.0120	.0000	.0234	1.9	.0300
14696	July 24	None.	V. slight.	.02	5.40	.0000	.0042	.44	.0230	.0000	.1155	2.6	.0100
14885	Aug. 21	V. slight.	V. slight.	.03	5.60	.0000	.0026	.40	.0170	.0000	.0624	2.1	.0050
15203	Sept. 18	None.	None.	.02	5.40	.0002	.0020	.41	.0170	.0000	.0546	2.2	.0090
15407	Oct. 21	Slight.	Slight.	.10	6.30	.0000	.0032	.45	.0200	.0000	.0796	2.7	.0180
15578	Nov. 20	None.	V. slight	.03	7.00	.0006	.0016	.49	.0320	.0000	.0608	2.9	.0080
15737	Dec. 17	V. slight.	V. slight.	.03	4.90	.0004	.0026	.43	.0500	.0000	.0346	2.1	.0070
Av.	....	....	....	.03	5.85	.0001	.0023	.42	.0230	.0000	.0566	2.4	.0146

Averages by Years.

-	1887*	-	-	.00	4.97	.0005	.0070	.38	.0047	-	-	-	-
-	1888	-	-	.01	4.64	.0009	.0111	.35	.0072	.0001	-	-	-
-	1889	-	-	.00	3.93	.0002	.0061	.30	.0126	.0001	-	-	-
-	1890†	-	-	.00	-	.0000	.0014	.32	.0250	.0001	-	-	-
-	1891†	-	-	.00	4.25	.0002	.0072	.31	.0250	.0000	-	1.8	-
-	1892	-	-	.02	5.13	.0006	.0028	.35	.0190	.0001	-	2.4	-
-	1893	-	-	.03	5.08	.0004	.0019	.38	.0194	.0000	.0856	2.3	.0119
-	1894	-	-	.03	5.99	.0001	.0021	.40	.0157	.0000	.0542	2.7	.0110
-	1895	-	-	.03	5.85	.0001	.0023	.42	.0230	.0000	.0566	2.4	.0146

* June to December. † February.

NOTE to analyses of 1895: Odor, none. —— The samples were collected from a faucet at the pumping station.

Analyses for the years 1887 to 1890, inclusive, represent water drawn from an open filter-basin. In 1890 the works for collecting ground water were enlarged by the construction of a long wooden filter-gallery, reinforced by tubular wells. A portion of this gallery, 732 feet in length, replaced an equal portion of the old open filter-basin. In 1892 the remaining portion of the open filter-basin was replaced by an extension of the filter-gallery, and after December of that year the water pumped for the supply of the city was not exposed to light at any point. In 1894 the works were again enlarged by the construction of a collecting conduit 3,268 feet long and by driving 52 tubular wells which are connected with the conduit.

NEWTON.

Microscopical Examination of Water from a Faucet at the Newton Water Works Pumping Station.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	19	-	21	21	25	22	19	23	21	18
Number of sample,	13648	13839	13988	14162	14331	14506	14696	14885	15203	15407	15578	15737
PLANTS.												
Fungi, Crenothrix,	2	24	26	-	0	2	0	38	0	128	2	10
Miscellaneous, Zoöglœa,	0	0	0	-	0	0	0	52	0	0	0	0
TOTAL,	2	24	26	-	0	2	0	90	0	128	2	10

Chemical Examination of Water from the Covered Distributing Reservoir of the Newton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13647	Jan. 14	V. slight.	Cons., rusty.	.02	4.80	.0006	.0088	.42	.0150	.0000	.1043	2.6	.0400
13840	Feb. 19	V. slight.	Slight.	.02	5.80	.0002	.0028	.41	.0170	.0000	.0312	2.5	.0280
13989	Mar. 18	None.	Slight, rusty.	.00	5.30	.0002	.0016	.40	.0200	.0000	.0411	2.6	.0130
14163	Apr. 17	None.	Slight.	.00	6.50	.0000	.0016	.39	.0170	.0000	.0355	3.0	.0130
14332	May 21	Slight.	Cons., rusty.	.02	6.10	.0000	.0056	.38	.0250	.0000	.0592	3.1	.0280
14697	July 24	None.	V. slight.	.02	6.10	.0000	.0020	.44	.0130	.0000	.0847	3.4	.0090
14884	Aug. 21	Slight.	Slight,	.03	7.50	.0000	.0038	.42	.0100	.0000	.0858	3.6	.0030
15204	Sept. 18	None.	None.	.02	7.60	.0012	.0028	.40	.0130	.0000	.0936	3.4	.0030
15408	Oct. 21	V slight.	Cons.	.06	8.10	.0000	.0050	.44	.0180	.0000	.0858	4.0	.0700
15579	Nov. 20	None.	V. slight.	.05	7.50	.0008	.0032	.54	.0220	.0000	.0780	3.4	.0110
15738	Dec. 17	V. slight.	V. slight.	.05	7.10	.0014	.0038	.49	.0470	.0000	.0477	3.2	.0340
Av.	....	....	....	.03	6.58	.0004	.0037	.43	.0197	.0000	.0679	3.2	.0229

Averages by Years.

-	1892	-	-	.03	6.40	.0022	.0038	.35	.0246	.0003	-	3.0	.0242
-	1893	-	-	.04	6.40	.0000	.0027	.38	.0220	.0000	.0678	3.0	.0196
-	1894	-	-	.03	6.44	.0002	.0038	.40	.0149	.0000	.0680	2.9	.0352
-	1895	-	-	.03	6.58	.0004	.0037	.43	.0197	.0000	.0679	3.2	.0229

NOTE to analyses of 1895: Odor, in March and November, faintly unpleasant; in May and October, distinctly unpleasant; at other times, none; on heating, a distinctly unpleasant odor was developed in the January sample and a distinctly disagreeable odor in the December sample. —— The samples were collected from the reservoir.

NEWTON.

Microscopical Examination of Water from the Covered Distributing Reservoir of the Newton Water Works.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Mar.	Apr.	May.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	19	–	21	26	22	21	23	21	18
Number of sample,	13647	13840	13989	14163	14332	14697	14884	15204	15408	15579	15738
PLANTS.											
Algæ, Zoöspores,	0	0	0	–	0	0	0	5	0	0	0
Fungi, Crenothrix,	84	20	30	–	44	3	156	192	2	0	0
ANIMALS.											
Infusoria, Trachelomonas,	0	0	0	–	0	0	0	2	0	0	0
Miscellaneous, Zoöglœa,	0	0	0	–	96	0	3	0	0	10	0
TOTAL,	84	20	30	–	140	3	159	199	2	10	0

Chemical Examination of Water from a Faucet in Newton supplied from the Newton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
14507	**1895.** June 20	V. slight.	None.	.03	5.50	.0000	.0014	.35	.0170	.0000	.0078	1.8	.0090

Odor, none. —— The sample was collected from a faucet at Newton Upper Falls.

Microscopical Examination.

Algæ, *Protococcus*, 10.

NEWTON.

Chemical Examination of Water from the Main Underdrain of the Hyde Brook Division of the Newton Sewerage System.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14175	Apr. 17	None.	Cons., earthy.	.01	21.90	.0120	.0048	2.20	.6500	.0007	.0750	8.1	.0020
14883	Aug. 21	V. slight.	None.	.02	34.40	.0000	.0022	3.25	.4850	.0008	.0468	12.4	.0050
15767	Dec. 18	Distinct.	Slight, rusty.	.04	20.90	.0096	.0026	1.87	.5400	.0001	.0385	8.7	.0400
Av.	....	....	....	.02	25.73	.0072	.0032	2.44	.5583	.0005	.0534	9.7	.0157

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1891*	-	-	.00	26.05	.0200	.0036	3.15	1.5000	.0050	-	10.7	-
-	1892	-	-	.00	27.08	.0126	.0029	3.18	1.1666	.0015	-	10.1	.0052
-	1893	-	-	.03	25.43	.0140	.0037	2.48	0.9550	.0018	.0640	9.4	.0099
-	1894	-	-	.03	26.27	.0105	.0034	2.67	0.9933	.0012	.0451	9.2	.0033
-	1895	-	-	.02	25.73	.0072	.0032	2.44	0.5583	.0005	.0534	9.7	.0157

* December.

NOTE to analyses of 1895: Odor, none.——The samples were collected from the underdrain at its outlet.

Microscopical Examination.

No. 14175. Fungi, *Crenothrix*, 7.
No. 14883. Fungi, *Crenothrix*, 2. Infusoria, *Peridinium*, 1. Miscellaneous, *Zoöglœa*, 9. Total, 12.
No. 15767. Fungi, *Crenothrix*, 102.

Chemical Examination of Water from the Main Underdrain of the Cheesecake Brook Division of the Newton Sewerage System.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14174	Apr. 17	None.	Slight.	.04	18.30	.0142	.0050	1.42	.3650	.0007	.0160	8.3	.0160
14881	Aug. 21	Slight, milky.	Slight, rusty.	.04	20.40	.0176	.0014	1.84	.2350	.0005	.0280	6.6	.0280
15768	Dec. 18	Distinct.	Slight, rusty.	.02	19.20	.0058	.0050	1.25	.3500	.0001	.0447	8.0	.0420
Av.	....	....	....	.03	19.30	.0125	.0038	1.50	.3167	.0004	.0296	7.6	.0287

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1893*	-	-	.08	15.83	.0075	.0016	1.51	.3225	.0006	.0217	6.0	.0520
-	1894	-	-	.04	20.53	.0265	.0040	2.05	.5567	.0030	.0489	7.9	.0340
-	1895	-	-	.03	19.30	.0125	.0038	1.50	.3167	.0004	.0296	7.6	.0287

* July to December.

NOTE to analyses of 1895: Odor, none, becoming distinctly unpleasant in the second sample on heating.——The samples were collected from the underdrain at its outlet.

Microscopical Examination.

No. 14174. Fungi, *Crenothrix*, 180.
No. 14881. Fungi, *Crenothrix*, 82. Infusoria, *Peridinium*, 1. Miscellaneous, *Zoöglœa*, 8. Total, 91.
No. 15768. Fungi, *Crenothrix*, 210.

NEWTON.

Chemical Examination of Water from the Main Underdrain Beneath the Laundry Brook Valley Sewer, Newton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14176	Apr. 17	V. slight.	Cons., rusty.	.03	19.10	.0164	.0110	1.90	0.4350	.0004	.0869	8.3	.1400
14882	Aug. 21	Slight.	Slight, rusty.	.04	20.50	.0078	.0018	2.30	0.4000	.0002	.0250	6.7	.0250
15766	Dec. 18	Decided, clayey.	Cons., earthy.	.03	25.50	.0074	.0074	2.07	1.0300	.0013	.0216	10.4	.0000
Av.	....	....	....	.03	21.70	.0105	.0067	2.09	0.6217	.0006	.0445	8.5	.0550

Averages by Years.

-	1893*	-	-	.08	16.90	.0082	.0026	1.51	0.3500	.0006	.0782	7.1	.0525
-	1894	-	-	.04	17.23	.0103	.0019	1.68	0.3767	.0005	.0509	6.8	.0447
-	1895	-	-	.03	21.70	.0105	.0067	2.09	0.6217	.0006	.0445	8.5	.0550

* October and December.

NOTE to analyses of 1895: Odor, none.——The samples were collected from the underdrain at its outlet.

Microscopical Examination.

No. 14176. Fungi, *Crenothrix*, 380. Miscellaneous, *Zoöglœa*, 18. Total, 398.
No. 14882. Fungi, *Crenothrix*, 1,760.
No. 15766. Algæ, *Zoöspores*, 1.

WATER SUPPLY OF NORTH ADAMS.

Chemical Examination of Water from Notch Brook and Broad Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
15268	Sept. 26	None.	Slight.	.08	11.00	2.25	.0000	.0026	.0024	.0002	.10	.0030	.0000	.0780	8.6
15272	Sept. 27	V. slight.	V. slight.	.03	4.80	0.65	.0000	.0048	.0038	.0010	.06	.0030	.0000	.1108	3.8

Odor of the first sample, none; of the last, faintly musty, disappearing on heating.——The first sample was collected from Notch Brook, just above the point where the supply is taken for North Adams; the last, from Broad Brook at point where supply is taken.

Microscopical Examination.

No. 15268. Diatomaceæ, *Fragilaria*, 3; *Navicula*, 4; *Pinnularia*, 1; *Surirella*, 1; *Synedra*, 3. Cyanophyceæ, *Oscillaria*, 1. Fungi, *Crenothrix*, 400. Total, 413.
No. 15272. Diatomaceæ, *Melosira*, 3.

NORTH ADAMS.

Chemical Examination of Water from Tubular Wells used as an Auxiliary Supply for North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
15269	Sept. 26	None.	V. slight.	.00	27.50	.0000	.0000	.35	.3150	.0000	.0039	20.0	.0020

Odor, none. —— The sample was collected from the pump drawing water from the wells.

Microscopical Examination.

Fungi, *Crenothrix*, 1.

Water Supply of Northampton.

Chemical Examination of Water from the Upper Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14451	June 10	V. slight.	Slight.	.30	4.35	1.95	.0002	.0112	.0090	.0022	.09	.0050	.0001	.4251	1.6
15209	Sept. 17	Distinct.	Slight.	.15	4.45	0.85	.0006	.0104	.0066	.0038	.16	.0000	.0000	.2457	2.2
15416	Oct. 22	Slight.	Slight.	.40	5.25	1.75	.0006	.0146	.0134	.0012	.16	.0030	.0001	.5889	2.1
15641	Nov. 29	None.	V. slight.	.47	3.85	1.25	.0004	.0084	.0068	.0016	.12	.0020	.0000	.5460	1.3
15815	Dec. 28	Slight.	Slight.	.47	3.95	1.50	.0006	.0144	.0128	.0016	.11	.0030	.0000	.6044	1.1
Av.	....	....	....	.36	4.37	1.46	.0005	.0118	.0097	.0021	.13	.0026	.0000	.4820	1.7

Odor, faintly vegetable. —— The samples were collected from the reservoir about 1 foot beneath the surface.

Microscopical Examination.

The average number of organisms found in these samples was 176.

NORTHAMPTON.

Chemical Examination of Water from Roberts' Meadow Brook, just above the Middle Reservoir of the Northampton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14759	Aug. 1	V. slight.	Slight.	.40	5.25	1.50	.0008	.0140	.0132	.0008	.14	.0050	.0000	.6084	3.1
14927	Aug.27	None.	V. slight.	.28	5.70	1.70	.0004	.0108	.0088	.0020	.14	.0050	.0003	.2808	1.8
15210	Sept.17	V. slight.	Slight.	.17	4.55	0.90	.0004	.0078	.0054	.0024	.15	.0030	.0000	.1856	2.2
15417	Oct. 22	V. slight.	Slight.	.35	5.05	1.65	.0002	.0132	.0110	.0022	.16	.0030	.0002	.4992	2.1
15642	Nov. 29	None.	V. slight.	.49	3.75	1.35	.0000	.0104	.0074	.0030	.14	.0000	.0000	.5343	1.3
15818	Dec. 28	Slight.	Slight.	.50	4.00	1.65	.0010	.0232	.0216	.0016	.12	.0030	.0000	.5867	1.1
Av.	....	....	....	.36	4.72	1.46	.0005	.0132	.0112	.0020	.14	.0032	.0001	.4492	1.9

Odor, faintly vegetable or none, generally somewhat stronger on heating. —— The samples were collected from the stream, just above the reservoir.

Microscopical Examination of Water from Roberts' Meadow Brook, just above the Middle Reservoir of the Northampton Water Works.

[Number of organisms per cubic centimeter.]

	1895.					
	Aug.	Aug.	Sept.	Oct.	Dec.	Dec.
Day of examination,	6	30	-	25	2	31
Number of sample,	14759	14927	15210	15417	15642	15818
PLANTS.						
Diatomaceæ,	**31**	**520**	-	**0**	**1**	**0**
Cyclotella,	6	520	-	0	0	0
Navicula,	5	0	-	0	0	0
Pinnularia,	5	0	-	0	0	0
Synedra,	15	0	-	0	1	0
Algæ, Raphidium,	**12**	**0**	-	**0**	**0**	**0**
Fungi, Crenothrix,	**4**	**48**	-	**92**	**2**	**1**
Miscellaneous, Zoöglœa,	**0**	**0**	-	**6**	**0**	**10**
TOTAL,	47	568	-	98	3	11

NORTHAMPTON.

Chemical Examination of Water from the Middle Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14452	June 10	V. slight.	Slight.	.40	4.05	1.75	.0006	.0158	.0142	.0016	.10	.0030	.0001	.5164	1.7
14760	Aug. 1	V. slight.	Cons., green.	.40	5.00	1.65	.0004	.0198	.0144	.0054	.15	.0030	.0000	.5616	2.3
14928	Aug. 27	V. slight.	Slight.	.40	4.65	1.55	.0000	.0176	.0154	.0022	.11	.0000	.0000	.4602	1.8
15212	Sept. 17	Distinct, green.	Slight.	.67	4.85	1.55	.0002	.0186	.0146	.0040	.12	.0030	.0000	.4493	2.3
15418	Oct. 22	Distinct.	Cons., brown.	.90	5.25	2.35	.0040	.0246	.0234	.0012	.17	.0050	.0001	.9766	1.8
15643	Nov. 29	Slight.	Slight.	.70	4.25	1.65	.0000	.0124	.0112	.0012	.14	.0030	.0000	.7176	1.3
15816	Dec. 28	Distinct, clayey.	Slight.	.50	3.90	1.55	.0002	.0178	.0156	.0022	.10	.0000	.0000	.6160	1.1
Av.	....	....	....	.57	4.56	1.72	.0008	.0181	.0156	.0025	.13	.0024	.0000	.6140	1.8

Odor as follows: in June, distinctly vegetable and unpleasant; on August 1, distinctly vegetable and unpleasant; on August 27, disagreeable; in September and December, none, becoming vegetable on heating; in October and November, faintly vegetable, becoming stronger on heating.—— The samples were collected from the reservoir at depths of from 6 inches to 2 feet beneath the surface.

Microscopical Examination of Water from the Middle Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1895. June.	1895. Aug.	1895. Aug.	1895. Sept.	1895. Oct.	1895. Dec.	1895. Dec.
Day of examination,	12	6	30	21	25	2	31
Number of sample,	14452	14760	14928	15212	15418	15643	15816
PLANTS.							
Diatomaceæ,	**3**	**10,019**	**1,727**	**2,336**	**196**	**4**	**6**
Cyclotella,	0	10,000	1,720	2,280	192	0	0
Navicula,	0	5	1	4	2	0	0
Pinnularia,	0	5	0	0	0	0	0
Synedra,	2	8	6	52	2	4	2
Tabellaria,	1	1	0	0	0	0	4
Algæ,	**346**	**40**	**2**	**2**	**0**	**0**	**0**
Protococcus,	346	0	0	0	0	0	0
Staurastrum,	0	40	2	2	0	0	0
Fungi,	**0**	**36**	**0**	**2**	**36**	**6**	**2**
Crenothrix,	0	36	0	2	36	2	2
Molds,	0	0	0	0	0	4	0

NORTHAMPTON.

Microscopical Examination of Water from the Middle Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook, collected near the Surface — Concluded.

[Number of organisms per cubic centimeter.]

	1895.						
	June.	Aug.	Aug.	Sept.	Oct.	Dec.	Dec.
ANIMALS.							
Infusoria,	**1,214**	**156**	**10**	**45**	**50**	**0**	**0**
Codonella,	0	0	0	8	0	0	0
Dinobryon,	894	153	0	0	0	0	0
Dinobryon cases,	320	0	0	5	0	0	0
Euglena,	0	0	0	0	7	0	0
Peridinium,	0	3	4	26	1	0	0
Phacus,	0	0	0	2	2	0	0
Tintinnidium,	0	0	0	1	0	0	0
Trachelomonas,	0	0	6	3	40	0	0
Vermes,	**0**	**0**	**3**	**14**	**2**	**0**	**0**
Anurea,	0	0	1	14	2	0	0
Rotifer,	0	0	2	0	0	0	0
Miscellaneous,	**0**	**0**	**.04**	**.08**	**100**	**120**	**40**
Acarina,	0	0	.04	.08	0	0	0
Zoöglœa,	0	0	0	0	100	120	40
TOTAL,	1,563	10,251	1,742	2,399	384	130	48

Chemical Examination of Water from the Middle Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14761	Aug. 1	Distinct.	Cons., brown.	2.50	8.00	2.45	.0520	.0342	.0242	.0100	.15	.0050	.0000	0.9438	3.4
14929	Aug.27	V. slight.	Cons., brown.	3.30	8.50	2.80	.0232	.0260	.0188	.0072	.13	.0000	.0001	0.7800	2.3
15211	Sept.17	Distinct.	Slight.	3.30	8.35	2.40	.0156	.0320	.0216	.0104	.15	.0030	.0000	1.3650	2.7
15419	Oct. 22	Distinct.	Cons., brown.	0.90	5.05	2.15	.0038	.0262	.0210	.0052	.16	.0100	.0001	0.9672	1.8
15644	Nov.29	Distinct.	Slight.	0.70	4.10	1.80	.0004	.0146	.0122	.0024	.13	.0020	.0000	0.7176	1.3
15817	Dec. 28	Distinct, clayey.	Slight.	0.47	3.60	1.25	.0006	.0156	.0116	.0040	.12	.0030	.0000	0.5482	0.8
Av.	....	....	....	1.86	6.27	2.14	.0159	.0247	.0182	.0065	.14	.0038	.0000	0.8870	2.0

Odor of the first three samples, offensive; of the others, vegetable.——Iron, No. 14761, .9750; No. 14929, .4000; No. 15211, .8600; No. 15419, .0480; No. 15644, not determined; No. 15817, .0230.

NORTHAMPTON.

Microscopical Examination of Water from the Middle Storage Reservoir of the Northampton Water Works on Roberts' Meadow Brook, collected near the Bottom.

[Number of organisms per cubic centimeter.]

	1895.					
	Aug.	Aug.	Sept.	Oct.	Dec.	Dec.
Day of examination,	6	30	25	25	2	31
Number of sample,	14761	14929	15211	15419	15644	15817
PLANTS.						
Diatomaceæ,	**498**	**783**	**8**	**232**	**14**	**5**
Cyclotella,	496	780	2	228	0	0
Diatoma,	0	0	6	1	0	0
Meridion,	0	0	0	1	3	0
Navicula,	0	3	0	0	3	0
Synedra,	0	0	0	2	4	5
Tabellaria,	2	0	0	0	4	0
Algæ,	**142**	**115**	**0**	**0**	**0**	**0**
Glœocapsa,	128	0	0	0	0	0
Protococcus,	0	115	0	0	0	0
Raphidium,	14	0	0	0	0	0
Fungi, Crenothrix,	**960**	**116**	**560**	**120**	**7**	**3**
ANIMALS.						
Infusoria,	**24**	**5**	**10**	**48**	**0**	**0**
Dinobryon cases,	24	1	0	0	0	0
Monas,	0	1	0	0	0	0
Trachelomonas,	0	3	10	48	0	0
Vermes, Anurea,	**0**	**1**	**0**	**1**	**0**	**0**
Miscellaneous, Zoöglœa,	**0**	**0**	**20**	**200**	**0**	**80**
TOTAL,	1,624	1,020	598	601	21	88

Chemical Examination of Water from the Lower Reservoir of the Northampton Water Works on Roberts' Meadow Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended		Nitrates.	Nitrites.		
14453	1895. June 10	Distinct.	Cons.	.32	4.25	1.45	.0050	.0204	.0158	.0046	.09	.0050	.0000	.5008	1.7

Odor, decidedly vegetable and unpleasant.

Microscopical Examination.

Diatomaceæ, *Cyclotella*, 1; *Fragilaria*, 16; *Melosira*, 2; *Tabellaria*, 8. Algæ, *Protococcus*, 330. Fungi, *Crenothrix*, 2. Infusoria, *Dinobryon*, 1,280; *Dinobryon cases*, 800. Crustacea, *Cyclops*, .01. Miscellaneous, *Acarina*, .01. Total, 2,439.

NORTH ATTLEBOROUGH.

Water Supply of North Attleborough.

Chemical Examination of Water from the Wells of the North Attleborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14036	Mar. 25	None.	V. slight.	.03	5.85	.0002	.0012	.63	.0430	.0000	.0077	2.9	.0050
14573	July 1	None.	None.	.00	6.60	.0002	.0012	.73	.0400	.0000	.0213	2.6	.0000
15420	Oct. 23	None.	None.	.00	7.80	.0008	.0010	.72	.0550	.0000	.0429	3.1	.0010
15747	Dec. 16	None.	V. slight.	.00	6.20	.0000	.0024	.65	.0430	.0000	.0216	2.9	.0020
Av.	....	....	....	.01	6.61	.0003	.0014	.68	.0452	.0000	.0234	2.9	.0020

Averages by Years.

-	1887*	-	-	.00	6.28	.0001	.0011	.50	.0290	-	-	-	-
-	1888	-	-	.00	6.27	.0002	.0018	.50	.0288	.0000	-	-	-
-	1889†	-	-	.00	6.09	.0000	.0012	.55	.0414	.0000	-	-	-
-	1892‡	-	-	.00	5.95	.0008	.0018	.53	.0416	.0000	-	3.0	-
-	1893§	-	-	.00	5.88	.0003	.0005	.60	.0450	.0000	.0109	2.8	.0040
-	1894	-	-	.04	6.84	.0009	.0010	.70	.0508	.0001	.0169	3.1	.0178
-	1895	-	-	.01	6.61	.0003	.0014	.68	.0452	.0000	.0234	2.9	.0020

* June to December. † January to May. ‡ April to December. § March and July.

NOTE to analyses of 1895: Odor, none. The following odors were developed on heating: first sample, none; second, distinct, peculiar; third, faintly acid; last, distinctly earthy.——The samples were collected from a faucet in the pumping station.

Microscopical Examination.

No. 14036. Fungi, *Crenothrix*, 14. Miscellaneous, *Zoöglæa*, 40. Total, 54.
No organisms were found in the other samples.

Water Supply of Northborough.

Chemical Examination of Water from the Upper Reservoir of the Northborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
15792	Dec. 23	V. slight.	Slight.	.87	3.15	1.35	.0004	.0200	.0180	.0020	.11	.0050	.0000	.7007	0.5

Odor, distinctly vegetable.——The sample was collected from the reservoir.

Microscopical Examination.

Diatomaceæ, *Navicula*, 3; *Tabellaria*, 9. Miscellaneous, *Zoöglæa*, 5. Total, 17.

NORTHBOROUGH.

Chemical Examination of Water from the Lower Reservoir of the Northborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14190	Apr.21	Slight.	Slight.	.75	3.05	1.45	.0000	.0196	.0160	.0036	.23	.0000	.0000	.7110	0.8
14925	Aug.28	Slight.	Slight.	.70	4.45	2.05	.0000	.0298	.0246	.0052	.24	.0030	.0000	.7956	0.9
15791	Dec.23	V. slight.	V. slight.	.65	3.35	1.25	.0006	.0160	.0134	.0026	.13	.0030	.0000	.6545	0.5
Av.	....	....	....	.70	3.62	1.58	.0002	.0218	.0180	.0038	.20	.0020	.0000	.7204	0.7

Odor of the first sample, very faintly vegetable, becoming stronger on heating; of the other samples, distinctly vegetable.—— The samples were collected from the reservoir.

Microscopical Examination.

The number of organisms per cubic centimeter found in each of these samples was as follows: No. 14190, 133; No. 14925, 839; No. 15791, 6.

Chemical Examination of Water from Faucets in Northborough supplied from the Northborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14191	Apr.21	V. slight.	V. slight.	.75	3.15	1.65	.0000	.0130	.0118	.0012	.21	.0050	.0000	.6754	0.9
14926	Aug.28	Distinct.	Cons., brown.	.75	4.70	2.15	.0002	.0298	.0244	.0054	.27	.0050	.0003	.7332	1.0

Odor of the first sample, very faintly vegetable; of the last, decidedly disagreeable.

Microscopical Examination.

The number of organisms per cubic centimeter found in each of these samples was as follows: No. 14191, 25; No. 14926, 369.

NORTH BROOKFIELD.

Water Supply of North Brookfield.

Chemical Examination of Water from Doane Pond, North Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13680	Jan. 16	V. slight.	Slight.	0.40	7.45	1.80	.0238	.0358	.0274	.0084	.29	.0230	.0009	.5056	3.1
13860	Feb. 20	Distinct.	Cons.	0.80	7.50	1.80	.0338	.0374	.0296	.0078	.32	.0150	.0002	.4524	2.7
14010	Mar. 20	Decided.	Cons., green.	0.15	4.30	1.00	.0002	.0494	.0214	.0280	.20	.0050	.0001	.3223	1.7
14166	Apr. 17	Distinct, clayey.	Slight.	0.20	4.20	1.35	.0086	.0320	.0254	.0066	.24	.0180	.0001	.3357	1.6
14324	May 20	Distinct.	Cons.	0.50	4.15	1.10	.0002	.0420	.0340	.0080	.21	.0030	.0001	.4803	1.4
14494	June 19	Decided.	Slight, yellow.	0.50	3.95	1.95	.0018	.0356	.0272	.0084	.21	.0050	.0000	.5772	1.3
14703	July 24	Distinct.	Cons.	1.30	4.95	2.35	.0050	.0462	.0420	.0042	.26	.0030	.0000	.8624	1.7
14891	Aug. 21	Decided.	Cons., yellow.	0.95	4.55	1.85	.0004	.0486	.0384	.0102	.17	.0000	.0000	.7410	1.6
15240	Sept. 24	Slight.	Cons.	0.28	4.65	1.40	.0120	.0268	.0208	.0060	.24	.0180	.0007	.3900	1.9
15401	Oct. 21	Distinct.	Slight.	0.40	4.55	1.65	.0036	.0412	.0372	.0040	.19	.0070	.0001	.5577	1.7
15585	Nov. 20	Slight.	Slight.	0.30	4.45	1.55	.0010	.0220	.0206	.0014	.13	.0080	.0001	.4368	1.1
15769	Dec. 18	Decided.	Slight.	0.30	4.30	1.40	.0004	.0212	.0186	.0026	.13	.0180	.0001	.4096	1.1
Av.	1895	....	....	0.51	4.92	1.60	.0076	.0365	.0285	.0080	.22	.0102	.0002	.5059	1.7
Av.	1894	....	....	0.91	4.24	1.77	.0110	.0353	.0280	.0073	.19	.0054	.0001	.6192	1.1

Note to analyses of 1895: Odor, generally distinctly vegetable, very rarely none; in December, faintly oily. —— The samples were collected from the pond.

Microscopical Examination of Water from Doane Pond, North Brookfield.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	22	20	18	21	20	26	22	26	23	21	19
Number of sample,	13680	13860	14010	14166	14324	14494	14703	14891	15240	15401	15585	15769
PLANTS.												
Diatomaceæ,	**2**	**0**	**0**	**40**	**383**	**369**	**1,133**	**354**	**0**	**268**	**144**	**4**
Asterionella,	pr.	0	0	2	65	171	11	32	0	140	44	4
Cyclotella,	0	0	0	3	1	0	0	9	0	0	0	0
Fragilaria,	0	0	0	5	0	6	2	0	0	0	0	0
Navicula,	0	0	0	2	7	1	0	1	0	4	0	0
Synedra,	2	0	0	7	284	14	0	0	0	28	44	0
Tabellaria,	0	0	0	21	26	177	1,120	312	0	96	56	0

NORTH BROOKFIELD.

Microscopical Examination of Water from Doane Pond, North Brookfield — Concluded.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.												
Cyanophyceæ,	**0**	**0**	**0**	**0**	**15**	**0**	**1**	**9**	**0**	**5**	**0**	**0**
Chroöcoccus,	0	0	0	0	15	0	0	4	0	0	0	0
Microcystis,	0	0	0	0	0	0	1	5	0	5	0	0
Algæ,	**0**	**0**	**0**	**1**	**453**	**59**	**1,117**	**4,962**	**4**	**230**	**15**	**0**
Arthrodesmus,	0	0	0	0	0	7	5	76	0	2	0	0
Chlorococcus,	0	0	0	0	4	0	0	0	0	3	0	0
Cosmarium,	0	0	0	0	0	0	4	6	0	0	0	0
Glœocapsa,	0	0	0	0	2	0	4	11	0	0	0	0
Pediastrum,	0	0	0	0	2	0	1	70	0	0	0	0
Protococcus,	0	0	0	0	172	42	220	440	0	0	5	0
Raphidium,	0	0	0	0	57	0	840	2,284	4	180	8	0
Scenedesmus,	0	0	0	1	168	1	3	16	0	7	1	0
Staurastrum,	0	0	0	0	32	9	40	2,052	0	24	1	0
Staurogenia,	0	0	0	0	16	0	0	7	0	14	0	0
Fungi, Crenothrix,	**1**	**0**	**0**	**2**	**3**	**3**	**11**	**1**	**0**	**0**	**0**	**0**
ANIMALS.												
Infusoria,	**1**	**61**	**15,567**	**28**	**950**	**228**	**9**	**836**	**15**	**90**	**34**	**381**
Cryptomonas,	0	0	100	0	0	0	0	0	0	0	0	0
Dinobryon,	0	0	5	6	348	228	0	28	0	38	21	376
Dinobryon cases,	0	0	0	0	600	0	0	748	0	52	3	0
Enchelys,	0	0	0	0	0	0	0	40	0	0	0	0
Euglena,	1	13	60	14	0	0	0	0	0	0	0	0
Monas,	0	0	2	0	0	0	0	5	0	0	0	0
Peridinium,	0	48	15,400	8	1	0	4	8	0	0	3	0
Trachelomonas,	0	0	0	0	1	0	5	7	15		0	0
Uroglena,	0	0	0	0	0	0	0	0	0	0	7	5
Vermes,	**0**	**0**	**0**	**2**	**2**	**2**	**1**	**1**	**1**	**0**	**0**	**0**
Anurea,	0	0	0	0	0	2	1	0	1	0	0	0
Polyarthra,	0	0	0	1	1	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	1	1	0	0	1	0	0	0	0
Crustacea, Daphnia,	**0**	**0**	**0**	**0**	**0**	**0**	**.02**	**0**	**.08**	**0**	**0**	**0**
Miscellaneous,	**0**	**340**	**540**	**312**	**332**	**0**	**0**	**88**	**160**	**200**	**20**	**0**
Acarina,	0	0	0	0	0	0	0	.06	.02	.04	0	0
Zoöglœa,	0	340	540	312	332	0	0	88	160	200	20	0
TOTAL,	4	401	16,107	385	2,138	661	2,272	6,251	180	793	213	385

NORTH BROOKFIELD.

Chemical Examination of Water from the Filtered-water Well of the North Brookfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13681	Jan. 16	V. slight.	Slight.	0.23	6.40	1.20	.0406	.0362	.0270	.0092	.27	.0150	.0000	.4250	2.7
13861	Feb. 20	Slight.	V slight.	0.02	8.75	1.10	.0560	.0170	.0112	.0058	.20	.0100	.0001	.1342	3.6
14011	Mar. 20	Decided.	Slight.	0.02	8.40	1.40	.0402	.0202	.0114	.0088	.24	.0120	.0002	.1540	3.6
14167	Apr. 17	Distinct, clayey.	Slight.	0 23	4.00	1.10	.0042	.0188	.0138	.0050	.22	.0150	.0001	.2891	1.6
14325	May 20	Distinct.	Slight.	0.50	3.85	1.05	.0000	.0292	.0222	.0070	.22	.0030	.0000	.4677	1.6
14495	June 19	Slight, milky.	V. slight.	0.12	5.30	2.55	.0008	.0132	.0112	.0020	.20	.0170	.0004	.1677	1.7
14704	July 24	Distinct.	Cons., rusty.	1.10	5.15	2.15	.0152	.0424	.0292	.0132	.24	.0030	.0000	.7469	1.7
14892	Aug. 21	Slight.	Slight.	0.90	4.20	2.30	.0004	.0328	.0254	.0074	.20	.0000	.0000	.5538	1.1
15241	Sept. 24	Distinct.	Cons.	0.40	4.30	1.80	.0022	.0386	.0336	.0050	.24	.0090	.0000	.5476	1.4
15402	Oct. 21	Distinct.	Slight.	0.30	4.00	1.15	.0026	.0252	.0216	.0036	.19	.0130	.0000	.4407	1.7
15586	Nov. 20	Slight.	Slight.	0.30	4.60	1.50	.0006	.0214	.0192	.0022	.16	.0070	.0001	.3939	1.4
15770	Dec. 18	Slight, clayey.	Slight.	0.33	2.65	0.65	.0012	.0114	.0096	.0018	.16	.0030	.0001	.1309	1.1
Av.	1895	....	....	0.37	5.13	1.50	.0137	.0255	.0196	.0059	.21	.0089	.0001	.3710	1.9
Av.	1894	....	....	0.73	4.68	1.86	.0096	.0286	.0252	.0034	.19	.0095	.0002	.5427	1.6

NOTE to analyses of 1895: Odor, generally distinctly vegetable, often also unpleasant; very rarely none.—— The samples were collected from the filtered-water well.

Microscopical Examination of Water from the Filtered-water Well of the North Brookfield Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	17	22	21	18	21	20	26	22	26	23	21	20
Number of sample, ...	13681	13861	14011	14167	14325	14495	14704	14892	15241	15402	15586	15770
PLANTS.												
Diatomaceæ, ...	**2**	**1**	**0**	**19**	**235**	pr.	**650**	**16**	**672**	**46**	**3**	**0**
Asterionella, ...	2	0	0	0	31	0	0	8	12	17	2	0
Synedra, ...	0	1	0	2	188	pr.	2	pr.	432	20	1	0
Tabellaria, ...	0	0	0	17	16	0	648	8	228	9	0	0

NORTH BROOKFIELD.

Microscopical Examination of Water from the Filtered-water Well of the North Brookfield Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.												
Algæ,	**0**	**0**	**0**	**20**	**495**	**pr.**	**2,838**	**1,586**	**177**	**98**	**0**	**0**
Arthrodesmus,	0	0	0	0	2	0	0	12	0	5	0	0
Closterium,	0	0	0	0	2	0	0	0	4	1	0	0
Cosmarium,	0	0	0	0	0	0	12	1	2	0	0	0
Glœocapsa,	0	0	0	0	1	0	2,400	2	0	0	0	0
Protococcus,	0	0	0	20	380	0	72	114	9	0	0	0
Raphidium,	0	0	0	0	4	0	320	604	64	80	0	0
Sceuedesmus,	0	0	0	0	68	pr.	6	12	7	1	0	0
Selenastrum,	0	0	0	0	0	0	0	0	7	0	0	0
Staurastrum,	0	0	0	0	32	0	26	838	76	7	0	0
Staurogenia,	0	0	0	0	6	0	2	3	8	4	0	0
Fungi, Crenothrix,	**2**	**0**	**0**	**7**	**2**	**0**	**212**	**0**	**0**	**1**	**44**	**3**
ANIMALS.												
Infusoria,	**8**	**12**	**130**	**15**	**1,152**	**0**	**112**	**189**	**103**	**50**	**0**	**0**
Dinobryon,	2	0	0	0	416	0	0	36	12	6	0	0
Dinobryon cases,	0	0	0	0	736	0	0	136	88	40	0	0
Enchelys,	0	0	0	0	0	0	0	10	0	0	0	0
Euglena,	3	0	96	11	0	0	0	0	0	0	0	0
Monas,	1	0	2	0	0	0	2	1	0	1	0	0
Peridinium,	2	12	32	2	0	0	2	3	0	1	0	0
Tintinnidium,	0	0	0	0	0	0	4	0	0	0	0	0
Trachelomonas,	0	0	0	2	0	0	104	3	3	2	0	0
Vermes,	**pr.**	**0**	**0**	**0**	**9**	**0**	**4**	**0**	**1**	**0**	**0**	**0**
Anurea,	0	0	0	0	3	0	2	0	0	0	0	0
Polyarthra,	0	0	0	0	3	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	3	0	0	0	1	0	0	0
Rotifer,	pr.	0	0	0	0	0	2	0	0	0	0	0
Miscellaneous,	**660**	**800**	**2,480**	**136**	**0**	**0**	**0**	**106**	**236**	**60**	**160**	**0**
Acarina,	0	0	0	0	0	0	0	0	.12	0	0	0
Zoöglœa,	660	800	2,480	136	0	0	0	106	236	60	160	0
TOTAL,	672	813	2,610	197	1,893	pr.	3,816	1,897	1,189	255	207	3

NORTON.

Chemical Examination of Water from a Tributary of the Wading River in the Westerly Part of Norton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
15432	1895. Oct. 25	None.	V. slight.	2.00	9.80*	5.20	.0074	.0486	-	-	.53	.0050	.0000	3.0264	2.5

* Unfiltered.

Odor, none, becoming distinctly vegetable on heating. —— The sample was collected from a filter-well in a brook near the factory of A. H. Sweet, in the vicinity of Main Street.

Microscopical Examination.

Algæ, *Raphidium*, 1. Fungi, *Molds*, 1. Vermes, *Rotifer*, 1. Miscellaneous, *Zoöglœa*, 72. Total, 75.

WATER SUPPLY OF NORWOOD.

The organism *Uroglena* reappeared in the water of Buckmaster Pond in October, 1895, and increased rapidly in numbers during the remainder of the year. The taste and odor of the water became very disagreeable, and the water continued to give serious trouble from this cause in the early part of 1896.

Chemical Examination of Water from Brooks flowing into Buckmaster Pond, Dedham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
15596	1895. Nov. 20	V. slight.	V. slight.	0.40	3.40	1.50	.0000	.0100	.0084	.0016	.36	.0030	.0001	0.5132	0.5
15597	Nov. 20	V. slight.	V. slight.	1.00	4.30	2.35	.0000	.0130	.0118	.0012	.25	.0000	.0001	1.0803	0.5

Odor, distinctly vegetable, becoming less strong on heating. —— The first sample was collected from a small brook flowing into the north-westerly side of the pond, and the last from a brook flowing into the north-easterly side of the pond.

Microscopical Examination.

No. 15596. Diatomaceæ, *Diatoma*, 4; *Melosira*, 10; *Navicula*, 4. Miscellaneous, *Zoöglœa*, 4. Total, 22.

No. 15597. Diatomaceæ, *Diatoma*, 2; *Meridion*, 1; *Navicula*, 4. Miscellaneous, *Zoöglœa*, 10. Total, 17.

NORWOOD.

Chemical Examination of Water from Buckmaster Pond, Dedham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13600	Jan. 3	V. slight.	V. slight.	.07	3.20	1.15	.0182	.0210	.0174	.0036	.36	.0030	.0000	.1809	1.1
13772	Feb. 5	V. slight.	V. slight.	.40	2.90	0.90	.0028	.0186	.0140	.0046	.30	.0150	.0000	.3673	0.6
13933	Mar. 5	Slight.	Cons.	.10	3.05	1.00	.0054	.0262	.0144	.0118	.35	.0080	.0000	.2233	0.8
14088	Apr. 2	Slight.	Slight.	.12	2.90	0.95	.0092	.0178	.0150	.0028	.36	.0090	.0000	.2680	0.8
14260	May 7	Slight.	Slight.	.18	2.90	1.25	.0006	.0164	.0146	.0018	.35	.0000	.0000	.2934	0.5
14416	June 4	Slight.	Slight.	.20	2.60	1.20	.0000	.0184	.0164	.0020	.36	.0050	.0000	.3519	0.5
14597	July 9	Distinct.	Slight.	.15	3.60	2.20	.0000	.0206	.0188	.0018	.37	.0030	.0000	.3199	0.3
14777	Aug. 6	Distinct.	Slight.	.10	2.60	1.75	.0012	.0212	.0182	.0030	.40	.0180	.0000	.3198	0.3
14963	Sept. 2	Slight.	Cons., yellow.	.12	2.85	1.15	.0000	.0232	.0194	.0038	.41	.0020	.0001	.3041	0.2
15309	Oct. 2	Distinct.	Slight, green.	.12	2.65	1.15	.0010	.0302	.0236	.0066	.40	.0030	.0000	.2714	0.3
15480	Nov. 5	Decided.	Slight.	.12	2.90	1.10	.0074	.0244	.0194	.0050	.37	.0100	.0000	.2792	0.5
15667	Dec. 3	Decided.	Slight.	.20	3.30	1.05	.0106	.0262	.0180	.0082	.33	.0030	.0001	.2980	0.6
Av.	....	....	....	.16	2.95	1.24	.0047	.0220	.0174	.0046	.36	.0066	.0000	.2898	0.5

Averages by Years.

-	1887*	-	-	.09	2.64	1.06	.0058	.0212	-	-	.30	.0018	-	-	-
-	1888	-	-	.15	2.66	0.95	.0069	.0248	-	-	.29	.0065	.0001	-	-
-	1889	-	-	.11	2.43	0.78	.0025	.0196	.0172	.0024	.30	.0070	.0001	-	-
-	1890	-	-	.05	2.59	0.99	.0015	.0180	.0147	.0033	.30	.0075	.0000	-	1.0
-	1891	-	-	.06	2.48	0.97	.0014	.0166	.0140	.0026	.26	.0075	.0000	-	0.7
-	1892	-	-	.07	2.88	1.24	.0019	.0219	.0172	.0047	.32	.0067	.0000	-	0.7
-	1893	-	-	.07	2.62	1.08	.0052	.0199	.0156	.0043	.33	.0028	.0000	.2544	0.7
-	1894	-	-	.10	2.82	1.13	.0055	.0182	.0153	.0029	.36	.0028	.0000	.2373	0.5
-	1895	-	-	.16	2.95	1.24	.0047	.0220	.0174	.0046	.36	.0066	.0000	.2898	0.5

* June to December.

NOTE to analyses of 1895: Odor, frequently vegetable and unpleasant, sometimes none; in November and December, faintly oily, becoming stronger on heating. There was also an oily odor in the March sample on heating. —— The samples were collected from the pond.

NORWOOD.

Microscopical Examination of Water from Buckmaster Pond, Dedham.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	7	8	4	8	5	11	8	6	4	6	4
Number of sample,	13600	13772	13933	14088	14260	14416	14597	14777	14963	15309	15480	15667
PLANTS.												
Diatomaceæ,	**452**	**1**	**0**	**215**	**142**	**248**	**20**	**3**	**7**	**4**	**49**	**501**
Asterionella,	47	0	0	208	136	8	0	0	0	0	30	472
Cyclotella,	5	0	0	1	2	169	16	2	1	0	0	6
Melosira,	20	0	0	4	0	6	0	0	0	3	0	3
Navicula,	0	0	0	2	0	1	0	1	0	0	4	2
Stephanodiscus,	0	0	0	0	0	0	0	0	0	0	7	0
Synedra,	380	1	0	0	2	15	4	0	2	1	8	8
Tabellaria,	0	0	0	0	2	49	0	0	4	0	0	10
Cyanophyceæ, Microcystis,	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2**	**16**	**46**	**24**	**0**
Algæ,	**0**	**6**	**0**	**0**	**32**	**36**	**121**	**117**	**310**	**43**	**0**	**64**
Arthrodesmus,	0	0	0	0	3	2	2	1	0	0	0	0
Protococcus,	0	6	0	0	25	34	93	107	300	32	0	0
Raphidium,	0	0	0	0	4	0	26	9	10	3	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0	8	0	0
Ulothrix,	0	0	0	0	0	0	0	0	0	0	0	64
Fungi, Crenothrix,	**0**	**0**	**0**	**5**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ANIMALS.												
Rhizopoda, Arcella,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
Infusoria,	**3**	**104**	**68,008**	**515**	**98**	**30**	**4**	**112**	**1**	**11**	**129**	**56**
Cryptomonas,	0	0	0	100	0	0	0	0	0	0	0	1
Dinobryon,	0	20	68,000	260	0	5	0	0	0	0	0	0
Dinobryon cases,	3	76	0	152	96	0	0	0	0	0	104	24
Euglena,	0	2	0	0	0	0	0	0	0	0	0	0
Mallomonas,	0	0	0	1	0	25	0	0	0	0	0	0
Peridinium,	0	6	4	0	2	0	4	112	0	0	0	1
Trachelomonas,	0	0	4	2	0	0	0	0	1	0	0	0
Uroglena,	0	0	0	0	0	0	0	0	0	11	25	30
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**6**	**0**	**0**	**20**
TOTAL,	455	111	68,008	735	279	314	148	235	340	104	204	641

Table showing Heights of Water in Buckmaster Pond on the First of Each Month in 1895.

[Distance below crest of dam.]

DATE.—1895.	Feet.	DATE.—1895.	Feet.
Jan. 1,	3.58	July 1,	1.67
Feb. 1,	1.25	Aug. 1,	2.58
March 1,	1.42	Sept. 1,	3.83
April 1,	0.38	Oct. 1,	5.67
May 1,	0.02	Nov. 1,	4.58
June 1,	0.50	Dec. 1,	1.42

WATER SUPPLY OF ORANGE.

During 1895 a reservoir was constructed near the pumping station of the Orange water works for the purpose of collecting the water of a spring for use in supplying the town. The reservoir is oval in shape, 130 feet long, 75 feet wide and 10 feet deep, and when filled to the level of the overflow has a capacity of 600,000 gallons. The inside slopes of the basin are paved with field stones.

The organism *Uroglena* was found in considerable numbers in samples from the distributing reservoir collected in May and October. Examinations made in the early part of 1896 showed the presence of *Uroglena* in North Pond, one of the sources of supply of the town.

Chemical Examination of Water from North Pond, Orange.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13684	Jan. 16	Slight.	Slight.	0.88	3.45	1.70	.0084	.0210	.0200	.0010	.14	.0030	.0000	0.5964	0.9
13867	Feb. 20	V. slight.	Slight.	0.80	3.65	1.60	.0062	.0246	.0202	.0044	.06	.0050	.0000	0.6747	0.9
14017	Mar. 20	V. slight.	Slight, white.	0.12	2.30	0.95	.0018	.0244	.0208	.0036	.15	.0070	.0000	0.2646	0.3
14177	Apr. 17	None.	V. slight.	0.25	2.50	1.00	.0000	.0060	.0052	.0008	.16	.0030	.0000	0.3571	0.6
14329	May 20	Distinct.	Cons.	0.58	2.95	1.45	.0000	.0232	.0178	.0054	.11	.0000	.0000	0.6004	0.9
14504	June 19	Decided.	Cons., yellow.	0.93	3.30	2.25	.0012	.0378	.0332	.0046	.13	.0050	.0001	0.9048	0.6
14694	July 23	Slight.	Slight.	1.20	3.90	2.65	.0000	.0370	.0342	.0028	.21	.0000	.0000	1.0350	0.9
14896	Aug. 21	Distinct, green.	Slight.	1.20	3.70	2.55	.0020	.0394	.0372	.0022	.16	.0000	.0000	1.2090	0.5
15223	Sept. 19	Decided, green.	Slight, brown.	0.68	3.45	1.65	.0028	.0314	.0222	.0092	.16	.0030	.0000	0.7020	0.9
15427	Oct. 24	Distinct, green.	Slight, brown.	0.98	3.45	1.85	.0064	.0320	.0288	.0032	.16	.0030	.0000	0.7917	0.8
15592	Nov. 21	Slight.	Slight.	0.70	3.80	1.75	.0022	.0152	.0120	.0032	.11	.0030	.0000	0.7582	0.6
15774	Dec. 18	V. slight.	V. slight.	0.33	3.20	1.20	.0004	.0124	.0110	.0014	.12	.0070	.0001	0.4158	0.5
Av.	1895	....	....	0.72	3.30	1.72	.0026	.0254	.0219	.0035	.14	.0032	.0000	0.6925	0.7
Av.	1894	....	....	0.67	3.38	1.63	.0012	.0229	.0194	.0035	.13	.0019	.0000	0.5964	0.9

NOTE to analyses of 1895: Odor, vegetable, and sometimes unpleasant. —— The samples were collected from the pond.

ORANGE.

Microscopical Examination of Water from North Pond, Orange.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	23	21	18	21	20	25	23	21	25	22	20
Number of sample,	13684	13867	14017	14177	14329	14504	14694	14896	15223	15427	15592	15774
PLANTS.												
Diatomaceæ,	**26**	**4**	**1**	**2**	**1,365**	**510**	**56**	**112**	**10**	**128**	**13**	**4**
Asterionella,	14	4	0	0	292	452	51	41	0	62	1	0
Cyclotella,	0	0	0	0	0	9	0	8	0	0	0	0
Melosira,	0	0	0	0	45	0	0	48	3	53	8	0
Meridion,	3	0	0	2	0	0	0	0	0	0	0	3
Synedra,	pr.	0	1	0	332	9	3	3	0	9	4	1
Tabellaria,	9	0	0	0	696	40	2	12	7	4	0	0
Cyanophyceæ,	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**1**	**15**	**1**	**8**	**0**
Anabæna,	0	0	0	0	4	0	0	0	0	0	7	0
Clathrocystis,	0	0	0	0	0	0	0	1	15	1	1	0
Algæ,	**0**	**0**	**1**	**0**	**65**	**37**	**281**	**367**	**57**	**6**	**1**	**1**
Arthrodesmus,	0	0	0	0	0	1	5	2	0	0	0	0
Chlorococcus,	0	0	0	0	0	0	0	316	0	0	0	0
Conferva,	0	0	0	0	0	4	2	9	0	2	0	0
Glœocapsa,	0	0	0	0	0	5	16	20	2	0	0	0
Protococcus,	0	0	1	0	60	22	244	3	15	0	0	0
Raphidium,	0	0	0	0	2	0	11	2	14	2	0	1
Scenedesmus,	0	0	0	0	0	0	0	9	0	1	0	0
Selenastrum,	0	0	0	0	0	0	0	0	15	0	0	0
Staurastrum,	0	0	0	0	3	5	3	1	1	1	1	0
Staurogenia,	0	0	0	0	0	0	0	5	10	0	0	0
Fungi, Crenothrix,	**0**	**0**	**1**	**1**	**7**	**48**	**68**	**3**	**19**	**2**	**1**	**0**
ANIMALS.												
Rhizopoda, Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**24**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**34**	**1**	**1**	**771**	**45**	**18**	**23**	**7**	**3**	**0**	**3**
Dinobryon,	0	0	0	0	0	29	0	0	0	0	0	3
Dinobryon cases,	0	0	0	0	768	16	0	0	0	0	0	0
Mallomonas,	0	0	0	0	0	0	2	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	3	0	0	0	0
Peridinium,	pr.	33	1	1	1	0	7	19	0	0	0	0
Synura,	0	0	0	0	2	0	0	0	0	0	0	0
Trachelomonas,	0	1	0	0	0	0	9	1	7	3	0	0
Vermes,	**0**	**1**	**0**	**0**	**6**	**5**	**4**	**3**	**0**	**1**	**0**	**0**
Anurea,	0	0	0	0	1	5	0	0	0	1	0	0
Polyarthra,	0	0	0	0	3	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	2	0	1	3	0	0	0	0
Rotifer,	0	1	0	0	0	0	3	0	0	0	0	0
Crustacea, Daphnia,	**0**	**0**	**0**	**0**	**0**	**.30**	**.02**	**0**	**0**	**0**	**0**	**0**
Miscellaneous,	**0**	**0**	**6**	**0**	**0**	**0**	**3**	**.08**	**0**	**6**	**0**	**5**
Acarina,	0	0	0	0	0	0	0	.08	0	0	0	0
Zoöglœa,	0	0	6	0	0	0	3	0	0	6	0	5
TOTAL,	26	39	10	4	2,218	645	430	533	108	147	23	13

ORANGE.

Chemical Examination of Water from the Distributing Reservoir of the Orange Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13685	Jan. 16	V. slight.	V. slight.	.40	3.10	1.20	.0034	.0114	.0102	.0012	.15	.0070	.0000	.3673	0.9
13868	Feb. 20	None.	V. slight.	.23	2.85	0.90	.0006	.0082	.0052	.0030	.08	.0050	.0000	.2925	0.9
14018	Mar. 20	V. slight.	Slight.	.23	3.15	1.05	.0000	.0146	.0136	.0010	.15	.0100	.0001	.3492	0.8
14178	Apr. 17	V. slight.	Cons., earthy.	.20	2.55	0.95	.0014	.0106	.0086	.0020	.13	.0070	.0000	.3160	0.6
14330	May 20	Distinct.	Slight.	.20	2.70	1.20	.0000	.0120	.0080	.0040	.13	.0000	.0000	.3492	0.9
14505	June 19	Slight.	Slight.	.25	3.10	1.40	.0014	.0130	.0120	.0010	.13	.0030	.0000	.3705	0.6
14695	July 23	V. slight.	Slight.	.20	3.10	1.05	.0000	.0118	.0096	.0022	.18	.0030	.0000	.2850	0.8
14897	Aug. 21	Distinct, white.	Slight, white.	.25	3.50	1.50	.0000	.0122	.0106	.0016	.12	.0030	.0000	.4446	0.5
15224	Sept. 20	Slight.	Slight.	.25	3.60	1.05	.0006	.0132	.0122	.0010	.16	.0070	.0000	.3198	0.8
15428	Oct. 24	Slight, green.	Slight, green.	.15	3.20	0.70	.0000	.0098	.0056	.0042	.17	.0000	.0000	.2870	0.8
15593	Nov. 21	None.	Slight.	.08	3.25	0.70	.0000	.0010	.0010	.0000	.15	.0030	.0000	.1264	0.8
15775	Dec. 18	None.	V. slight.	.25	3.00	1.05	.0002	.0066	.0058	.0008	.11	.0090	.0000	.3811	0.5
Av.	1895	....	....	.22	3.09	1.06	.0006	.0103	.0085	.0018	.14	.0047	.0000	.3240	0.7
Av.	1894	....	....	.52	3.68	1.58	.0007	.0171	.0146	.0025	.14	.0028	.0001	.5136	0.8

NOTE to analyses of 1895: Odor, in January and March, none; in October, faintly oily; at other times vegetable, and rarely unpleasant. The odor of the October sample was stronger on heating. The odor of the sample collected in May was decidedly oily on heating. —— The samples were collected from the reservoir.

Microscopical Examination of Water from the Distributing Reservoir of the Orange Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	17	23	21	18	21	21	25	23	21	25	23	20
Number of sample, ...	13685	13868	14018	14178	14330	14505	14695	14897	15224	15428	15593	15775
PLANTS.												
Algæ, ...	0	0	0	0	0	0	4	211	1	0	0	0
Chlorococcus, ...	0	0	0	0	0	0	0	49	0	0	0	0
Raphidium, ...	0	0	0	0	0	0	0	140	1	0	0	0
Staurastrum, ...	0	0	0	0	0	0	4	22	0	0	0	0
Fungi, Crenothrix, ...	pr.	0	0	0	0	0	0	12	1	0	6	0

ORANGE.

Microscopical Examination of Water from the Distributing Reservoir of the Orange Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda, Actinophrys, . .	0	0	0	0	50	0	0	44	0	0	0	0
Infusoria, ...	0	72	174	84	58	0	5	38	19	124	1	0
Dinobryon, ...	0	0	9	84	0	0	0	11	17	0	0	0
Dinobryon cases, ...	0	72	164	0	0	0	2	0	1	100	0	0
Mallomonas, ...	0	0	0	0	0	0	3	0	0	0	0	0
Peridinium, ...	0	0	1	0	0	0	0	27	1	0	1	0
Uroglena, ...	0	0	0	0	58	0	0	0	0	24	0	0
Vermes, ...	0	0	0	0	0	0	3	pr.	3	0	0	0
Anurea, ...	0	0	0	0	0	0	3	pr.	1	0	0	0
Rotatorian ova, ...	0	0	0	0	0	0	0	0	2	0	0	0
Miscellaneous, ...	0	0	0	0	0	0	.02	156	.06	0	0	0
Acarina, ...	0	0	0	0	0	0	.02	0	.06	0	0	0
Zoöglœa, ...	0	0	0	0	0	0	0	156	0	0	0	0
TOTAL, ...	pr.	72	174	84	108	0	12	461	24	124	7	0

WATER SUPPLY OF PALMER FIRE DISTRICT, PALMER. — PALMER WATER COMPANY.

Chemical Examination of Water from Faucets in Palmer supplied from the Works of the Palmer Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
14617	July 15	Distinct.	Slight.	.45	3.65	1.30	.0004	.0130	.0096	.0034	.14	.0050	.0000	.3432	1.1
14858	Aug. 19	Distinct, clayey.	Slight, brown.	.90	4.85	2.50	.0004	.0238	.0220	.0018	.15	.0050	.0000	.8112	1.8

Odor of the first sample, distinctly vegetable and unpleasant, becoming also oily on heating; of the last, distinctly vegetable and disagreeable.

Microscopical Examination.

No. 14617. Diatomaceæ, *Cocconeis*, 1; *Cymbella*, 3; *Fragilaria*, 7; *Melosira*, 8; *Navicula*, 4; *Pinnularia*, 4; *Synedra*, 10; *Tabellaria*, 3. Cyanophyceæ, *Anabæna*, 5. Algæ, *Glœocapsa*, 1; *Pediastrum*, 1. Fungi, *Crenothrix*, 21. Infusoria, *Dinobryon*, 1,480; *Peridinium*, 1. Crustacea, *Daphnia*, .02. Total, 1,549.

No. 14858. Diatomaceæ, *Cyclotella*, 3; *Cymbella*, 1; *Diatoma*, 5; *Fragilaria*, 8; *Melosira*, 14; *Meridion*, 4; *Navicula*, 8; *Pinnularia*, 1; *Stephanodiscus*, 1; *Synedra*, 8; *Tabellaria*, 7. Cyanophyceæ, *Chroöcoccus*, 2. Algæ, *Pediastrum*, 2; *Protococcus*, 1; *Raphidium*, 2. Fungi, *Crenothrix*, 4; *Molds*, 1. Infusoria, *Peridinium*, 4. Miscellaneous, *Zoöglœa*, 200. Total, 276.

Paxton.

The advice of the State Board of Health to the town of Paxton relative to the use of water from Asnebumskit Pond as a public water supply may be found on page 38 of this volume. An analysis of a sample of water collected from this source in August, 1893, may be found on page 394 of the annual report for 1894.

Water Supply of Peabody.

Chemical Examination of Water from Brown's Pond, Peabody.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14105	Apr. 8	Distinct.	Slight.	.12	3.45	1.15	.0036	.0168	.0124	.0044	.58	.0070	.0000	.2425	0.8
14583	July 8	Slight.	Cons.	.25	3.05	1.15	.0002	.0172	.0154	.0018	.57	.0050	.0000	.3476	0.5
15329	Oct. 8	None.	V. slight.	.12	2.75	1.10	.0000	.0162	.0146	.0016	.59	.0000	.0000	.2886	0.6
Av.	....	....	....	.16	3.08	1.13	.0013	.0167	.0141	.0026	.58	.0040	.0000	.2929	0.6

Odor of the first sample, faintly vegetable, becoming disagreeable on heating; of the second, distinctly vegetable and mouldy; of the third, very faintly vegetable.—— The samples were collected from the pond.

Microscopical Examination of Water from Brown's Pond, Peabody.

[Number of organisms per cubic centimeter.]

	1895. April.	1895. July.	1895. October.
Day of examination,	9	9	10
Number of sample,	14105	14583	15329
PLANTS.			
Diatomaceæ,	**8**	**42**	**1**
Asterionella,	0	4	0
Cyclotella,	0	5	0
Navicula,	0	1	1
Synedra,	3	32	0
Tabellaria,	5	0	0
Cyanophyceæ,	**0**	**21**	**0**
Anabæna,	0	17	0
Merismopedia,	0	4	0

PEABODY.

Microscopical Examination of Water from Brown's Pond, Peabody — Concluded.

[Number of organisms per cubic centimeter.]

	1895. April.	1895. July.	1895. October.
PLANTS — Con.			
Algæ,	**21**	**14**	**0**
Glœocapsa,	0	2	0
Protococcus,	21	9	0
Scenedesmus,	0	3	0
Fungi, Crenothrix,	**0**	**5**	**1**
ANIMALS.			
Infusoria,	**584**	**2**	**0**
Dinobryon,	248	0	0
Dinobryon cases,	332	0	0
Mallomonas,	3	0	0
Peridinium,	0	2	0
Trachelomonas,	1	0	0
TOTAL,	613	84	2

Chemical Examination of Water from Spring Pond, Peabody.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14104	Apr. 8	Distinct.	Cons., earthy.	.02	4.45	1.25	.0016	.0132	.0092	.0040	.78	.0040	.0000	.1617	1.7
14582	July 8	Slight.	Cons.	.05	3.90	0.80	.0014	.0164	.0136	.0028	.69	.0000	.0000	.1896	1.8
15330	Oct. 8	V. slight.	Slight, brown.	.03	3.75	1.55	.0000	.0122	.0098	.0024	.71	.0000	.0000	.1778	1.6
Av.	....	....	....	.03	4.03	1.20	.0010	.0139	.0109	.0030	.73	.0013	.0000	.1764	1.7

Odor of the first sample, distinctly disagreeable; of the second, decidedly vegetable and mouldy; of the last, very faintly vegetable. —— The samples were collected from the pond.

PEABODY.

Microscopical Examination of Water from Spring Pond, Peabody.

[Number of organisms per cubic centimeter.]

	1895.		
	April.	July.	October.
Day of examination,	9	9	10
Number of sample,	14104	14582	15330
PLANTS.			
Diatomaceæ,	**1**	**78**	**244**
Pinnularia,	0	2	0
Synedra,	1	4	52
Tabellaria,	0	72	192
Cyanophyceæ,	**0**	**16**	**34**
Anabæna,	0	16	0
Chroöcoccus,	0	0	2
Microcystis,	0	0	32
Algæ,	**0**	**3**	**9**
Protococcus,	0	3	0
Raphidium,	0	0	9
Fungi, Crenothrix,	**0**	**6**	**0**
ANIMALS.			
Infusoria,	**18**	**0**	**1**
Dinobryon cases,	10	0	0
Monas,	7	0	0
Peridinium,	0	0	1
Trachelomonas,	1	0	0
TOTAL,	19	103	288

Chemical Examination of Water from the Lower Basin, Peabody Water Works

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14106	Apr. 8	Distinct.	Cons., earthy.	.02	5.00	1.15	.0060	.0096	.0064	.0032	.66	.0600	.0003	.1039	1.8
15331	Oct. 8	V.slight.	Slight.	.03	4.70	1.75	.0022	.0136	.0124	.0012	.78	.0180	.0001	.1466	2.1

Odor, none, becoming very faintly vegetable on heating. —— The samples were collected from the basin.

Microscopical Examination.

No. 14106. Diatomaceæ, *Diatoma*, 1; *Synedra*, 4. Infusoria, *Ciliated infusorian*, 1; *Dinobryon*, 11; *Dinobryon cases*, 27. Total, 44.

No. 15331. Diatomaceæ, *Cymbella*, 4; *Diatoma*, 4; *Navicula*, 2; *Synedra*, 2. Cyanophyceæ, *Anabæna*, 1. Algæ, *Pediastrum*, 1; *Raphidium*, 6. Total, 20.

PEABODY.

Chemical Examination of Water from a Fountain in Peabody, supplied from the Peabody Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14584	July 8	Slight.	Slight.	.05	4.60	1.15	.0010	.0154	.0138	.0016	.75	.0230	.0004	.1659	1.8

Odor, faintly vegetable, becoming stronger and unpleasant on heating.

Microscopical Examination.

Diatomaceæ, *Cyclotella*, 2; *Cymbella*, 1; *Navicula*, 5; *Pinnularia*, 4; *Synedra*, 7. Algæ, *Cosmarium*, 1; *Pediastrum*, 1; *Protococcus*, 41; *Raphidium*, 1; *Scenedesmus*, 3. Fungi, *Crenothrix*, 4. Infusoria, *Peridinium*, 10. Vermes, *Anurea*, 3. Total, 83.

Pepperell.

The advice of the State Board of Health to the town of Pepperell in relation to a water supply for the town may be found on pages 38–40 of this volume. In connection with the investigation, samples of water were taken from five different sources in the town and in its vicinity, the results of the analyses of which are given below.

Chemical Examination of Water from Brooks in Pepperell and Vicinity.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14273	May 10	V.slight.	Slight.	0.80	3.90	1.90	.0006	.0190	.0174	.0016	.19	.0000	.0000	.6891	1.1
14274	May 10	V.slight.	Cons.	1.05	5.30	2.85	.0010	.0252	.0238	.0014	.19	.0030	.0000	.8739	2.2
14275	May 10	V.slight.	Cons.	0.70	5.25	2.05	.0014	.0128	.0120	.0008	.22	.0050	.0000	.5390	3.0
14276	May 10	V.slight.	Cons.	0.78	3.20	2.10	.0018	.0186	.0168	.0018	.16	.0000	.0000	.7546	0.9
15405	Oct. 22	V.slight.	Slight.	0.90	5.80	2.75	.0010	.0332	.0310	.0022	.30	.0020	.0001	.9360	2.5

Odor of the first four samples, distinctly vegetable; of the last, none, becoming distinctly vegetable on heating. —— The samples were collected as follows: No. 14273, from Gulf Brook at the road crossing just above its junction with the Nissitissit River; No. 14274, from Unquetenasset Brook, below the Worcester and Nashua Division of the Boston & Maine Railroad, just above the crossing of the road from Pepperell to Hollis, New Hampshire; No. 14275, from Sucker Brook, just above where it joins the Nissitissit River; No. 14276, from the Nissitissit River, just above Sucker Brook; No. 15405, from Kemp's millpond, on Robinson's Brook, South Pepperell.

Microscopical Examination.

The number of organisms per cubic centimeter found in these samples was as follows: No. 14273, 54; No. 14274, 174; No. 14275, 54; No. 14276, 297; No. 15405, 76.

Water Supply of Pittsfield.

In the latter part of 1895 the city of Pittsfield constructed works for taking water for the supply of the city from Mill Brook in Washington and Lenox. A dam was constructed upon the brook, forming a small reservoir at such an elevation that the water will be supplied to the city by gravity. It is said that no water was supplied to the city from this source during 1895.

In the latter part of the year the city applied to the State Board of Health for advice with reference to increasing its water supply, and during the investigations relative to an additional water supply samples of water from several sources in the vicinity of the city were analyzed, the results of which are given in the tables which follow. Analyses of samples of water from West Pond and Roaring Brook may be found under Washington.

The advice of the State Board of Health to the Onota Water Company of Pittsfield relative to the introduction of water from May Brook for the supply of that portion of the city of Pittsfield in the vicinity of West Street may be found on pages 40 and 41 of this volume.

Chemical Examination of Water from Sacket Brook in the Vicinity of the Pumping Station of the Pittsfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
14824	1895. Aug.13	None.	Slight.	.05	11.50	1.95	.0004	.0042	.0034	.0008	.07	.0100	.0001	.0936	9.5

Odor, none, becoming distinctly vegetable on heating. —— The sample was collected from the brook.

Microscopical Examination.

Diatomaceæ, *Cyclotella*, 1; *Cymbella*, 11; *Fragilaria*, 3; *Melosira*, 11; *Navicula*, 5; *Synedra*, 31. Cyanophyceæ, *Oscillaria*, 2. Algæ, *Scenedesmus*, 2. Fungi, *Crenothrix*, 2. Total, 68.

PITTSFIELD.

Chemical Examination of Water from Sachem and Hollow Brooks, Lanesborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14819	Aug. 12	None.	V. slight.	.08	8.80	0.70	.0000	.0034	.0016	.0018	.07	.0170	.0001	.1248	6.9
15629	Nov. 27	Slight.	Cons., brown.	.15	7.75	1.40	.0004	.0080	.0060	.0020	.07	.0400	.0000	.2324	5.6
14823	Aug. 12	None.	Slight.	.03	6.80	0.50	.0000	.0016	.0012	.0004	.09	.0100	.0000	.0468	5.3
15628	Nov. 27	Slight.	Cons., earthy.	.08	3.40	0.75	.0002	.0050	.0042	.0008	.10	.0080	.0000	.1326	2.1

Odor of the first sample, none; of the second, faintly vegetable, becoming stronger on heating; of the third, none, becoming distinctly aromatic on heating; of the last sample, faintly vegetable. —— The first two samples were collected from Sachem Brook, a short distance above its junction with Hollow Brook; the last two samples from Hollow Brook, a short distance above its junction with Sachem Brook.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

Chemical Examination of Water from Smith and Lulu Brooks, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14820	Aug. 12	None.	V. slight.	.05	3.75	0.40	.0000	.0024	.0016	.0008	.08	.0030	.0001	.0858	2.7
15631	Nov. 27	None.	Slight.	.08	2.05	0.60	.0000	.0050	.0038	.0012	.11	.0000	.0000	.1388	0.6
15633	Nov. 27	-	-	.33	-	-	-	-	-	-	.11	-	-	-	2.1

Odor, none. —— The first two samples were collected from Smith Brook at the second road crossing above West Street, and the last sample from Lulu Brook, at the first road crossing above Onota Lake.

Microscopical Examination.

No. 15633 was not examined. An insignificant number of organisms was found in each of the other samples.

PITTSFIELD.

Chemical Examination of Water from Pontoosuc Lake, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14886	Aug. 20	Slight.	Slight.	.04	8.35	1.65	.0014	.0144	.0106	.0038	.10	.0000	.0000	.1482	6.0
14887	Aug. 20	Slight.	Slight.	.04	8.40	1.30	.0014	.0126	.0110	.0016	.11	.0000	.0000	.1560	6.0

Odor, distinctly vegetable and mouldy.——The first sample was collected near the dam; the last, near the Point of Pines.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

Chemical Examination of Water from May Brook, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14139	Apr. 12	V. slight.	Cons., earthy.	.03	1.95	0.45	.0000	.0030	.0016	.0014	.08	.0200	.0000	.0948	1.1
14189	Apr. 16	-	-	.08	-	-	-	-	-	-	.11	-	-	-	1.4
14821	Aug. 12	None.	V. slight.	.02	5.85	0.75	.0008	.0010	.0004	.0006	.05	.0100	.0000	.0468	4.3
15630	Nov. 27	None.	Slight.	.07	2.45	0.90	.0000	.0054	.0044	.0010	.13	.0070	.0000	.1560	0.9

Odor, none.——The samples were collected at the site of a proposed reservoir, about half a mile above West Street.

Microscopical Examination

An insignificant number of organisms was found in these samples.

PLYMOUTH.

WATER SUPPLY OF PLYMOUTH.

Chemical Examination of Water from Little South Pond, Plymouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13626	Jan. 8	Distinct.	Slight, green.	.04	1.85	0.40	.0002	.0134	.0104	.0030	.56	.0000	.0000	.1022	0.3
13704	Jan. 23	Slight.	V.slight.	.00	2.50	0.60	.0004	.0154	.0116	.0038	.66	.0000	.0000	.1201	0.2
13798	Feb. 12	V.slight.	Slight.	.03	2.90	0.65	.0000	.0152	.0130	.0022	.72	.0000	.0000	.1640	0.5
13958	Mar.12	V.slight.	V.slight.	.00	2.25	0.55	.0000	.0122	.0102	.0020	.64	.0030	.0000	.1578	0.2
14123	Apr. 9	V.slight.	Cons., earthy.	.00	2.10	0.55	.0000	.0142	.0098	.0044	.64	.0050	.0000	.0862	0.2
14277	May 13	Slight.	Slight.	.03	2.25	0.45	.0008	.0112	.0106	.0006	.60	.0030	.0000	.1027	0.5
14448	June 11	V.slight.	V.slight.	.02	2.25	1.15	.0002	.0108	.0098	.0010	.60	.0030	.0000	.0936	0.0
14628	July 15	Slight.	Cons.	.05	2.40	1.35	.0004	.0148	.0136	.0012	.64	.0050	.0000	.0390	0.0
14838	Aug.14	Slight.	Slight.	.02	2.15	0.25	.0000	.0184	.0148	.0036	.67	.0030	.0000	.1248	0.6
15127	Sept.10	Slight.	Slight.	.02	2.55	0.70	.0000	.0176	.0130	.0046	.68	.0000	.0000	.2028	0.5
15332	Oct. 9	V.slight.	V.slight.	.03	2.40	1.00	.0000	.0198	.0162	.0036	.67	.0050	.0000	.1654	0.2
15538	Nov.13	Slight.	V.slight.	.02	2.30	1.00	.0002	.0154	.0130	.0024	.66	.0050	.0000	.1014	0.2
15701	Dec.10	None.	Cons.	.02	2.65	1.20	.0008	.0214	.0134	.0080	.62	.0000	.0000	.1404	0.0
Av.	1895*	....	....	.02	2.36	0.78	.0002	.0155	.0124	.0031	.65	.0027	.0000	.1236	0.3
Av.	1894	....	....	.03	2.89	0.83	.0010	.0138	.0114	.0024	.66	.0008	.0000	.1151	0.2

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

NOTE to analyses of 1895: Odor, in January, distinctly sweetish; in February and March, none; during the remainder of the year, frequently vegetable, rarely mouldy; on January 23 and in November, faintly oily, becoming much stronger on heating. A decidedly oily odor was also detected in the samples collected in February and December, on heating. —— The samples were collected from the pond.

Microscopical Examination of Water from Little South Pond, Plymouth.

[Number of organisms per cubic centimeter.]

	1895.												
	Jan.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	9	24	13	13	10	13	12	17	15	11	10	14	10
Number of sample, ...	13626	13704	13798	13958	14123	14277	14448	14628	14838	15127	15332	15538	15701
PLANTS.													
Diatomaceæ, ...	**18**	**22**	**0**	**10**	**23**	**23**	**5**	**17**	**5**	**6**	**3**	**4**	**13**
Asterionella, ...	0	0	0	9	8	7	0	8	0	0	1	0	10
Cyclotella, ...	1	0	0	0	4	1	0	0	2	2	0	0	0
Synedra, ...	17	22	0	1	11	14	5	7	pr.	2	1	0	3
Tabellaria, ...	0	0	0	pr.	0	1	0	2	3	2	1	4	0
Cyanophyceæ, ...	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**3**	**16**	**22**	**22**	**7**	**0**
Anabæna, ...	0	0	0	0	0	0	7	0	13	2	1	0	0
Microcystis, ...	0	0	0	0	0	0	0	3	3	8	18	7	0
Oscillaria, ...	0	0	0	0	0	0	0	0	0	12	3	0	0

PLYMOUTH.

Microscopical Examination of Water from Little South Pond, Plymouth — Concluded.

[Number of organisms per cubic centimeter.]

	1895.												
	Jan.	Jan.	Feb	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.													
Algæ,	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**40**	**154**	**21**	**0**	**0**	**0**
Protococcus,	0	2	0	0	0	0	0	40	154	13	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0	8	0	0	0
ANIMALS.													
Infusoria,	**157**	**104**	**82**	**87**	**1**	**5**	**0**	**434**	**1**	**1**	**3**	**3**	**251**
Dinobryon,	30	13	11	68	0	0	0	424	0	0	0	0	0
Dinobryon cases,	93	90	60	17	1	5	0	0	0	0	0	0	1
Mallomonas,	0	0	0	0	0	0	0	6	1	0	3	0	0
Opalina,	0	0	0	0	0	0	0	4	0	0	0	0	0
Peridinium,	0	0	1	2	0	0	0	0	0	1	0	0	0
Uroglena,	34	1	10	0	0	0	0	0	0	0	0	3	250
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**30**	**0**	**0**	**0**	**16**	**0**	**40**	**0**
TOTAL,	175	128	82	97	24	58	12	494	176	66	28	54	264

WATER SUPPLY OF PROVINCETOWN.

Chemical Examination of Water from the Tubular Wells of the Provincetown Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13774	Feb. 6	Decided.	Cons., rusty.	0.80	7.90	.0062	.0120	1.80	.0030	.0000	.8137	2.3	.2200
13949	Mar. 6	Decided, iron.	Slight, rusty.	1.30	7.30	.0068	.0102	2.23	.0070	.0000	.6737	2.3	.3150
14092	Apr. 3	Distinct.	Cons., rusty.	1.20	8.50	.0080	.0094	2.25	.0070	.0000	.6968	2.1	.3500
14436	June 6	Decided.	Cons., rusty.	1.20	9.40	.0052	.0102	2.35	.0030	.0000	.7752	2.7	.4200
14793	Aug. 9	Decided, milky.	Cons., rusty.	1.30	9.70	.0070	.0112	2.18	.0040	.0000	.8424	1.8	.4300
15322	Oct. 7	Decided.	Cons., rusty.	1.40	8.60	.0080	.0110	2.35	.0030	.0000	.8073	2.5	.4200
15692	Dec. 9	Distinct.	Cons., rusty.	1.30	8.50	.0108	.0104	2.10	.0030	.0000	.7995	1.7	.4800
Av.	....	....	....	1.21	8.56	.0074	.0106	2.18	.0043	.0000	.7727	2.2	.3764

Averages by Years.

-	1893	-	-	0.99	7.65	.0027	.0082	2.08	.0023	.0001	.7425	1.4	.1340
-	1894	-	-	1.09	7.91	.0043	.0090	2.19	.0039	.0000	.6878	1.7	.2212
-	1895	-	-	1.21	8.56	.0074	.0106	2.18	.0043	.0000	.7727	2.2	.3764

NOTE to analyses of 1895: Odor in February and June, faintly vegetable; at other times, none. On heating, vegetable odors were developed in all of the samples except that collected in August, which had an earthy odor. —— The samples were collected from a faucet at the pumping station.

PROVINCETOWN.

Microscopical Examination of Water from the Tubular Wells of the Provincetown Water Works.

[Number of organisms per cubic centimeter.]

	1895. Feb.	Mar.	Apr.	June.	Aug.	Oct.	Dec.
Day of examination,	7	8	4	7	10	8	10
Number of sample,	13774	13949	14092	14436	14793	15322	15692
PLANTS.							
Fungi, Crenothrix,	13	1,240	148	12,880	36	736	26

Chemical Examination of Water from Faucets in Provincetown supplied from the Provincetown Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13619	Jan. 7	Distinct, milky.	Slight.	1.00	6.90	.0014	.0110	2.17	.0040	.0000	.6435	1.6	.1700
15693	Dec. 9	Decided.	Cons.	1.20	9.00	.0014	.0146	2.19	.0000	.0000	.6786	2.6	.5100

Odor of the first sample, very faintly unpleasant, becoming faintly vegetable on heating; of the second sample, none, becoming faintly vegetable on heating. — The samples represent water that had passed through the distributing tank.

Microscopical Examination.

No. 13619. Fungi, *Crenothrix*, 4.
No. 15693. Fungi, *Crenothrix*, 20,000.

Water Supply of Quincy.

Chemical Examination of Water from Town Brook just above the Storage Reservoir of the Quincy Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13695	Jan. 21	V. slight.	V. slight.	0.58	3.95	1.45	.0002	.0094	.0078	.0016	.64	.0060	.0000	0.4582	0.8
13884	Feb. 25	V. slight.	Slight.	0.50	4.40	0.90	.0000	.0134	.0114	.0020	.66	.0120	.0000	0.4266	0.6
14047	Mar. 27	V. slight.	Slight.	0.70	3.05	1.35	.0002	.0204	.0184	.0020	.49	.0030	.0000	0.6622	0.5
14206	Apr. 23	V. slight.	Slight.	0.90	3.75	2.25	.0002	.0258	.0192	.0066	.59	.0030	.0000	0.8374	0.5
14380	May 27	V. slight.	Cons.	1.60	5.50	2.95	.0002	.0280	.0260	.0020	.57	.0050	.0000	1.2236	0.9
14539	June 25	V. slight.	Cons.	0.70	4.25	1.65	.0002	.0154	.0140	.0014	.56	.0090	.0002	0.4504	0.8
14737	July 30	V. slight.	Slight.	0.90	4.45	1.30	.0000	.0164	.0148	.0016	.58	.0100	.0001	0.5082	0.9
14930	Aug. 28	None.	V. slight.	0.90	4.85	1.55	.0000	.0172	.0152	.0020	.76	.0070	.0002	0.3900	0.8
15246	Sept. 24	None.	Slight.	0.90	4.80	1.60	.0002	.0212	.0168	.0044	.60	.0090	.0000	0.5733	0.6
15435	Oct. 28	Slight.	Slight.	0.80	4.95	1.90	.0006	.0170	.0148	.0022	.64	.0030	.0001	0.7917	0.8
15624	Nov. 26	None.	V. slight.	0.85	4.10	2.10	.0006	.0132	.0108	.0024	.56	.0030	.0000	0.7426	0.3
15789	Dec. 23	Slight.	Slight.	0.70	3.70	1.75	.0002	.0150	.0130	.0020	.44	.0030	.0000	0.6622	0.3
Av.	....	....	....	0.84	4.31	1.73	.0002	.0177	.0152	.0025	.59	.0061	.0001	0.6439	0.6

Averages by Years.

-	1887*	-	-	0.50	5.30	1.50	.0000	.0133	-	-	.65	.0080	-	-	-
-	1888†	-	-	0.45	3.64	1.05	.0001	.0122	-	-	.54	.0070	.0003	-	-
-	1889	-	-	1.21	4.61	1.87	.0013	.0239	.0203	.0036	.48	.0073	.0001	-	-
-	1890	-	-	0.73	5.22	2.17	.0024	.0187	.0155	.0032	.52	.0125	.0002	-	1.3
-	1891	-	-	0.72	4.22	1.50	.0004	.0156	.0132	.0024	.49	.0112	.0001	-	0.7
-	1892	-	-	0.87	4.57	1.56	.0041	.0191	.0159	.0032	.55	.0114	.0001	-	0.8
-	1893	-	-	0.93	4.53	1.81	.0014	.0168	.0140	.0028	.57	.0110	.0001	.7298	0.8
-	1894	-	-	0.92	4.31	1.62	.0003	.0158	.0134	.0024	.63	.0030	.0000	.6379	0.6
-	1895	-	-	0.84	4.31	1.73	.0002	.0177	.0152	.0025	.59	.0061	.0001	.6439	0.6

* October. † November and December.

NOTE to analyses of 1895: Odor, vegetable; often also mouldy or unpleasant. —— The samples were collected from the brook above the reservoir.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 75.

QUINCY.

Chemical Examination of Water from the Storage Reservoir of the Quincy Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13696	Jan. 21	V. slight.	Slight.	.50	3.90	1.40	.0008	.0140	.0110	.0030	.62	.0050	.0000	.4542	0.8
13885	Feb. 25	Slight.	Slight.	.53	4.45	1.40	.0002	.0196	.0130	.0066	.68	.0130	.0000	.4384	0.6
14048	Mar. 27	Distinct.	Slight.	.45	3.10	0.60	.0058	.0188	.0134	.0054	.66	.0080	.0001	.3811	0.9
14207	Apr. 23	Distinct.	Cons.	.50	3.45	1.65	.0000	.0254	.0162	.0092	.61	.0030	.0002	.5490	0.5
14381	May 27	Distinct.	Cons.	.75	4.70	2.20	.0000	.0304	.0194	.0110	.68	.0000	.0000	.7030	0.8
14540	June 25	Distinct.	Cons., green.	.70	4.25	2.10	.0002	.0348	.0206	.0142	.70	.0000	.0000	.6198	0.8
14738	July 30	Distinct.	Cons., earthy.	.70	4.25	1.75	.0000	.0382	.0236	.0146	.66	.0080	.0000	.6083	0.9
14931	Aug. 28	Decided.	Cons.	.65	4.60	2.00	.0008	.0336	.0208	.0128	.74	.0030	.0001	.3510	0.8
15247	Sept. 24	Decided.	Cons., green.	.90	4.50	1.80	.0000	.0466	.0244	.0222	.68	.0030	.0000	.4898	0.5
15436	Oct. 28	Decided, green.	Cons., green.	.90	4.95	2.35	.0004	.0436	.0244	.0192	.66	.0000	.0000	.6903	0.8
15625	Nov. 26	Decided, green.	Cons., green.	.70	4.35	2.25	.0000	.0340	.0172	.0168	.58	.0020	.0000	.7878	0.6
15790	Dec. 23	Distinct.	Slight, green.	.63	4.20	1.70	.0012	.0224	.0210	.0014	.52	.0030	.0000	.5967	0.6
Av.	....	....	....	.66	4.22	1.77	.0008	.0301	.0187	.0114	.65	.0040	.0000	.5558	0.7

Averages by Years.

-	1888*	-	-	.50	3.95	1.13	.0030	.0178	.0132	.0046	.68	.0150	.0003	-	-
-	1889	-	-	.92	3.76	1.19	.0116	.0303	.0238	.0065	.53	.0087	.0003	-	-
-	1890	-	-	.70	4.56	1.76	.0085	.0249	.0178	.0071	.54	.0166	.0002	-	1.3
-	1891	-	-	.70	3.97	1.60	.0027	.0274	.0178	.0096	.50	.0100	.0000	-	0.7
-	1892	-	-	.62	4.07	1.41	.0051	.0237	.0175	.0062	.61	.0098	.0001	-	0.9
-	1893	-	-	.56	3.81	1.51	.0052	.0218	.0172	.0046	.61	.0104	.0001	.5052	0.8
-	1894	-	-	.67	4.26	1.71	.0020	.0229	.0167	.0062	.67	.0053	.0000	.5969	0.8
-	1895	-	-	.66	4.22	1.77	.0008	.0301	.0187	.0114	.65	.0040	.0000	.5558	0.7

* November and December.

NOTE to analyses of 1895: Odor, distinctly vegetable; in January and February, also unpleasant, and from March to August, inclusive, disagreeable. —— The samples were collected from the reservoir.

For heights of water in this reservoir see table on page 286.

QUINCY.

Microscopical Examination of Water from the Storage Reservoir of the Quincy Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May	June.	Aug.	Aug.	Sept	Oct.	Nov.	Dec.
Day of examination,	23	27	29	26	29	26	1	30	26	30	29	24
Number of sample,	13696	13885	14048	14207	14381	14540	14738	14931	15247	15436	15625	15790
PLANTS.												
Diatomaceæ,	**0**	**0**	**1**	**30**	**421**	**794**	**28**	**129**	**44**	**7**	**63**	**2**
Asterionella,	0	0	0	2	7	0	6	128	16	0	5	0
Diatoma,	0	0	0	0	2	0	0	0	2	0	4	0
Melosira,	0	0	0	8	6	0	4	0	0	5	0	0
Synedra,	0	0	1	2	360	780	15	1	24	2	54	2
Tabellaria,	0	0	0	18	46	14	3	0	2	0	0	0
Algæ,	**0**	**0**	**44**	**0**	**56**	**0**	**62**	**402**	**0**	**1**	**18**	**0**
Conferva,	0	0	44	0	56	0	0	0	0	1	1	0
Protococcus,	0	0	0	0	0	0	10	396	0	0	5	0
Raphidium,	0	0	0	0	0	0	52	6	0	0	12	0
Fungi, Crenothrix,	**0**	**0**	**0**	**1**	**0**	**0**	**4**	**0**	**36**	**48**	**0**	**0**
ANIMALS.												
Infusoria,	**48**	**1,110**	**112**	**169**	**73**	**256**	**288**	**182**	**152**	**0**	**2**	**0**
Dinobryon,	0	810	0	5	2	0	0	0	0	0	0	0
Dinobryon cases,	0	68	44	108	4	0	3	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	2	0	0	0	0
Tintinnidium,	0	0	0	0	3	0	1	0	0	0	0	0
Peridinium,	48	232	68	56	64	256	284	180	152	0	2	0
Vermes,	**0**	**0**	**0**	**0**	**1**	**0**	**4**	**1**	**2**	**0**	**1**	**0**
Anurea,	0	0	0	0	0	0	2	0	0	0	1	0
Polyarthra,	0	0	1	0	1	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	0	0	2	0	0	0	0	0
Rotifer,	0	0	0	0	0	0	0	1	2	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**268**	**0**	**0**	**0**	**0**	**0**	**80**	**80**	**0**	**3**
TOTAL,	48	1,110	425	200	551	1,050	386	714	314	136	84	5

Chemical Examination of Water from Blue Hill River, Braintree.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
14736	1895. July 30	V. slight.	Slight.	.65	4.15	1.95	.0010	.0250	.0228	.0022	.54	.0070	.0000	.6622	1.3

Odor, faintly vegetable. The sample was collected from the river at the point where it is crossed by West Street.

Microscopical Examination.

The number of organisms per cubic centimeter found in this sample was 182.

QUINCY.

Table showing Heights of Water in the Storage Reservoir of the Quincy Water Works on the Following Dates during 1895.

[High-water mark is 86.71 feet above city base.]

1895.	Heights above City Base.	1895.	Heights above City Base.
	Feet.		Feet.
Jan. 1,	85.71	July 1,	84.63
Feb. 1,	86.71	Aug. 1,	83.16
March 1,	86.71	Sept. 1,	80.47
April 1,	86.71	Oct. 1,	77.87
May 1,	86.71	Nov. 1,	80.39
June 4,	86.44	Dec. 1,	85.89

Water Supply of Randolph and Holbrook.

Chemical Examination of Water from Great Pond in Randolph and Braintree.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14588	July 8	Slight.	Slight.	.53	3.75	1.90	.0004	.0190	.0172	.0018	.58	.0050	.0000	.5767	1.4

Odor, very faintly vegetable, growing stronger on heating.——The sample was collected from a faucet in Holbrook.

Microscopical Examination.

Diatomaceæ, *Cyclotella*, 3; *Cymbella*, 1; *Fragilaria*, 2; *Melosira*, 2; *Pinnularia*, 1. Cyanophyceæ, *Anabæna*, 20; *Clathrocystis*, 1; *Microcystis*, 5. Algæ, *Glœocapsa*, 1; *Protococcus*, 41. Fungi, *Crenothrix*, 7. Total, 84.

Water Supply of Reading.

The advice of the State Board of Health relative to the purification of the public water supply of the town may be found on pages 41–45 of this volume. The results of analyses made during the investigation may be found on pages 297–300 of the annual report for 1894.

READING.

Chemical Examination of Water from the Filter-gallery of the Reading Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13613	Jan. 7	Distinct, milky.	Cons., floc.	0.04	17.70	.0072	.0122	1.00	.0050	.0000	.3354	7.9	.3300
13778	Feb. 7	Distinct.	Slight, white.	0.90	16.70	.0088	.0126	1.02	.0070	.0000	.4819	7.3	.1900
13938	Mar. 6	Distinct, floc.	Slight.	1.10	16.30	.0090	.0150	0.94	.0050	.0000	.5736	6.9	.3000
14091	Apr. 3	Distinct.	Cons., floc.	1.00	15.40	.0096	.0116	0.78	.0080	.0001	.3527	5.7	.2100
14259	May 7	Distinct.	Cons., floc.	1.20	14.00	.0082	.0146	0.74	.0030	.0001	.6583	5.3	.1700
14433	June 5	Distinct.	Slight, rusty.	1.10	13.80	.0120	.0162	0.72	.0050	.0000	.6969	4.9	.2000
14602	July 10	Distinct.	Cons., floc.	0.50	10.80	.0082	.0104	0.66	.0050	.0000	.3871	3.8	.0780
14780	Aug. 7	Distinct, milky.	Cons., yellow.	0.35	9.60	.0060	.0098	0.64	.0080	.0000	.4290	3.9	.1300
15000	Sept. 4	Decided.	Cons., rusty.	0.40	10.80	.0074	.0102	0.60	.0000	.0001	.3822	3.5	.1450
15346	Oct. 9	Decided, milky.	Cons., floc.	0.40	8.30	.0068	.0070	0.61	.0000	.0000	.3432	2.7	.1350
15499	Nov. 7	Distinct, milky.	Cons., rusty.	0.10	18.90	.0110	.0086	0.48	.0050	.0000	.3198	8.3	.4400
15678	Dec. 4	Decided, milky.	Cons., white.	0.20	14.30	.0110	.0086	0.45	.0070	.0000	.3750	6.4	.4050
Av.	....	....	....	0.61	13.88	.0088	.0114	0.72	.0048	.0000	.4446	5.5	.2277

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1891	-	-	0.13	12.96	.0016	.0063	.43	.0094	.0001	-	5.1	-
-	1892	-	-	0.44	9.25	.0042	.0073	.54	.0071	.0001	-	3.4	-
-	1893	-	-	0.64	10.08	.0034	.0087	.56	.0032	.0001	.3497	3.9	.1251
-	1894	-	-	0.45	12.76	.0043	.0107	.68	.0029	.0000	.3509	5.0	.2642
-	1895	-	-	0.61	13.88	.0088	.0114	.72	.0048	.0000	.4446	5.5	.2277

Note to analyses of 1895: Odor, vegetable or none. On heating, the odor became unpleasant in several of the samples. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination of Water from the Filter-gallery of the Reading Water Works.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, .	8	9	8	4	8	7	11	8	7	11	11	5
Number of sample, .	13613	13778	13938	14091	14259	14433	14602	14780	15000	15346	15499	15678
PLANTS.												
Fungi, Crenothrix, .	64	1,000	2,400	1,180	1,040	6,300	4,000	13,600	10,000	12,000	1,384	2,360

REVERE AND WINTHROP.

Water Supply of Revere and Winthrop. — Revere Water Company.

The works of the Revere Water Company for obtaining a supply of ground water at Cliftondale, Saugus, were enlarged in 1895 by sinking fifteen additional 2½-inch tubular wells in the immediate vicinity of those driven in previous years, forming an extension of the original system. The total number now connected with these works is 67.

The rapid increase in the amount of chlorine, residue on evaporation and hardness in the water of the wells located at Revere, which has been mentioned in previous reports, still continues, as may be seen in the table of yearly averages of analyses given below. It will be noticed in the table of monthly analyses in 1895 that the water deteriorated rapidly during the months when there was the greatest draft upon the wells, owing to the infiltration of sea water.

Chemical Examination of Water from the Wells of the Revere Water Company at Revere.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13635	Jan. 8	Slight, milky.	Cons., rusty.	.05	59.20	.0002	.0018	18.36	.0700	.0003	.0312	27.0	.0470
13944	Mar. 6	None.	None.	.02	63.80	.0000	.0000	20.95	.0230	.0012	.0308	29.0	.0050
14097	Apr. 3	None.	V. slight.	.00	65.10	.0000	.0004	20.90	.1400	.0025	.0462	30.0	.0050
14263	May 7	None.	None.	.00	69.70	.0002	.0006	21.70	.0350	.0033	.0308	27.0	.0070
14431	June 5	None.	None.	.00	91.80	.0000	.0018	31.05	.1000	.0014	.0418	40.0	.0050
14612	July 11	None.	None.	.00	108.30	.0002	.0008	38.60	.1200	.0013	.0632	49.5	.0000
14791	Aug. 8	None.	None.	.00	143.50	.0000	.0010	47.80	.1000	.0015	.1014	64.5	.0100
15022	Sept. 4	None.	None.	.00	154.30	.0000	.0010	57.50	.0300	.0013	.0702	48.5	.0040
15319	Oct. 7	None.	None.	.00	158.90	.0002	.0000	64.00	.0330	.0015	.0874	75.0	.0070
15497	Nov. 7	Distinct, clayey.	Slight, earthy.	.10	150.20	.0002	.0024	54.00	.0200	.0008	.1232	66.5	.0300
15688	Dec. 5	Distinct, clayey.	Cons., earthy.	.10	87.20	.0012	.0034	30.42	.0460	.0005	.1030	43.0	.0120
Av..	....	....	....	.02	104.73	.0002	.0012	36.84	.0652	.0014	.0663	45.5	.0120

Averages by Years.

-	1887*	-	-	.00	22.17	.0002	.0016	3.37	.1670	-	-	-	-
-	1888	-	-	.00	22.69	.0001	.0022	3.49	.1288	.0022	-	-	-
-	1889†	-	-	.00	22.72	.0000	.0016	3.28	.1330	.0027	-	-	-
-	1890‡	-	-	.00	-	.0008	.0012	3.39	.1750	.0024	-	-	-
-	1893	-	-	.00	50.29	.0002	.0019	13.05	.0907	.0019	.0439	23.0	.0036
-	1894	-	-	.03	91.99	.0004	.0011	30.80	.0963	.0013	.0576	41.0	.0219
-	1895	-	-	.02	104.73	.0002	.0012	36.84	.0652	.0014	.0663	45.5	.0120

* June to December. † January to May. ‡ March.

Note to analyses of 1895: Odor, none. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

Crenothrix was found in the samples collected in January, March, April, November and December, the largest number per cubic centimeter being 576, in January.

REVERE AND WINTHROP.

Chemical Examination of Water from Tubular Wells of the Revere Water Company, at Cliftondale, Saugus.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13636	Jan. 7	None.	None.	.03	13.90	.0000	.0020	1.26	.1140	.0000	.0312	6.6	.0010
13791	Feb. 6	None.	None.	.03	13.10	.0000	.0026	1.25	.1100	.0000	.0360	6.1	.0000
13945	Mar. 6	None.	None.	.00	13.00	.0000	.0008	0.85	.1560	.0000	.0115	6.6	.0000
14098	Apr. 3	None.	None.	.00	13.60	.0000	.0018	1.18	.1350	.0000	.0269	6.7	.0000
14264	May 7	None.	None.	.00	12.90	.0000	.0010	1.20	.0500	.0000	.0000	6.1	.0000
14430	June 5	None.	None.	.00	13.90	.0000	.0020	1.20	.0650	.0001	.0038	6.6	.0000
14611	July 11	None.	None.	.00	13.20	.0014	.0006	1.23	.1100	.0100	.0395	6.0	.0000
14792	Aug. 8	None.	None.	.00	14.70	.0012	.0010	1.18	.0750	.0300	.0702	10.5	.0030
15021	Sept. 4	None.	None.	.00	13.20	.0000	.0014	1.16	.1250	.0000	.0312	6.4	.0070
15318	Oct. 7	None.	None.	.00	12.90	.0006	.0000	1.24	.1100	.0000	.0273	6.9	.0020
15496	Nov. 8	None.	None.	.02	15.30	.0002	.0026	1.29	.1000	.0001	.0296	6.6	.0000
15687	Dec. 4	None.	None.	.02	13.80	.0000	.0034	1.15	.1200	.0000	.0390	7.4	.0000
Av..	....	....	....	.01	13.62	.0003	.0016	1.18	.1058	.0033	.0289	6.9	.0011

Averages by Years.

-	1891*	-	-	.00	11.50	.0018	.0014	0.88	.0100	.0000	-	5.3	-
-	1892	-	-	.01	11.65	.0000	.0003	1.16	.0123	.0035	-	6.0	.0116
-	1893	-	-	.00	12.60	.0002	.0010	1.32	.0872	.0079	.0252	6.4	.0037
-	1894	-	-	.01	13.08	.0000	.0010	1.24	.0706	.0012	.0257	6.5	.0058
-	1895	-	-	.01	13.62	.0003	.0016	1.18	.1058	.0033	.0289	6.9	.0011

* September.

Note to analyses of 1895: Odor, none. —— The samples were collected from faucets in Revere and Saugus supplied wholly from the Saugus wells.

Microscopical Examination.

No. 13791. Fungi, *Crenothrix*, 4.
No. 14098. Fungi, *Crenothrix*, 2.
No organisms were found in the other samples.

REVERE AND WINTHROP.

Chemical Examination of Water from Brooks in Saugus.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
15598	Nov. 20	V. slight.	Slight.	1.10	3.70	1.75	.0000	.0182	.0182	.0000	.55	.0180	.0001	0.9204	1.4
15599	Nov. 20	V. slight.	Slight.	0.42	4.15	1.90	.0000	.0112	.0098	.0014	.42	.0200	.0001	0.5304	1.1
15600	Nov. 20	Slight.	Slight.	1.00	5.75	2.55	.0006	.0250	.0234	.0016	.54	.0200	.0001	0.9243	1.9
15601	Nov. 20	Slight.	Cons., earthy.	1.20	8.20	3.55	.0122	.0420	.0380	.0040	.97	.0480	.0012	1.3455	2.5

Odor of the first two samples, distinctly vegetable and mouldy; of the last two faintly, vegetable. —— The first sample was collected from Crystal Brook, near the corner of Howard and Main streets; the second sample, from a tributary of Crystal Brook, near the corner of Howard and Main streets; the third sample, from Long Pond Brook, at the point where it crosses the Newburyport turnpike; the last sample, from a brook at the corner of Essex and Vine streets, above the point where it joins Long Pond Brook.

Microscopical Examination.

The total number of organisms per cubic centimeter found in these samples was as follows: No. 15598, 4; No. 15599, 155; No. 15600, 120; No. 15601, 283.

Water Supply of Rockland.

(See *Abington.*)

Water Supply of Rockport.

Population in 1895, 5289. The works are owned by the town and were completed in the early part of 1895. The source of supply is Cape Pond, situated in the southern part of the town. The area of the pond is 40 acres and its maximum depth is said to be about 26 feet. The pond has a watershed, including the area of the pond, of 214 acres, which contains a very small population. Water is pumped from the pond to the town and to an open iron tank, 30 feet in diameter and 60 feet in height and having a capacity of 317,000 gallons, located on Great Hill. Distributing mains are of cast iron and service pipes are of wrought iron lined with cement.

The advice of the State Board of Health to the town of Rockport relative to the use of this pond as a source of public water supply may be found on pages 45–47 of the annual report for 1893.

A further communication from the State Board of Health to the town of Rockport relative to the pollution of the water of the pond by waste matters from a glue factory may be found on page 65 of the annual report for 1894.

ROCKPORT.

Chemical Examination of Water from Cape Pond, Rockport.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13799	Feb. 12	Distinct.	Slight.	.30	13.50	1.90	.0056	.0264	.0236	.0028	5.40	.0030	.0000	.3360	1.4
14293	May 14	Distinct.	Cons., green.	.25	11.85	2.05	.0000	.0260	.0164	.0096	5.10	.0030	.0000	.3120	1.4
14833	Aug.13	Decided, green.	Slight, green.	.20	12.20	2.50	.0020	.0434	.0180	.0254	5.70	.0030	.0001	.3588	1.1
15536	Nov.12	V. slight.	V. slight.	.25	12.90	2.80	.0024	.0250	.0210	.0040	5.50	.0060	.0000	.2902	1.1
Av.	1895	....	....	.25	12.61	2.31	.0025	.0302	.0198	.0104	5.42	.0037	.0000	.3242	1.2
Av.	1894	....	....	.22	12.85	1.91	.0001	.0225	.0163	.0062	5.55	.0010	.0000	.2455	1.3

NOTE to analyses of 1895: Odor of the second sample, none; of the others, faintly vegetable. — The samples were collected from the pond.

Microscopical Examination of Water from Cape Pond, Rockport.

[Number of organisms per cubic centimeter.]

	1895. Feb.	1895. May.	1895. Aug.	1895. Nov.
Day of examination,	13	14	14	14
Number of sample,	13799	14293	14833	15536
PLANTS.				
Diatomaceæ,	1,000	37,850	0	3,366
Asterionella,	1,000	37,800	0	3,360
Melosira,	0	0	0	6
Synedra,	0	50	0	0
Cyanophyceæ, Anabæna,	0	0	1,300	0
ANIMALS.				
Infusoria,	460	1,150	550	12
Dinobryon,	0	50	0	0
Dinobryon cases,	440	1,100	0	0
Euglena,	0	0	0	8
Peridinium,	20	0	100	2
Trachelomonas,	0	0	450	2
Vermes, Anurea,	1	0	0	0
Crustacea, Daphnia,	0	.05	0	0
Miscellaneous, Acarina,	0	0	0	.02
TOTAL,	1,461	39,000	1,850	3,378

RUTLAND.

The advice of the State Board of Health to the town of Rutland relative to taking the water of Muschopauge Lake as a public water supply may be found on page 46 of this volume. The results of the analyses of two samples of water collected from the lake are given below.

Chemical Examination of Water from Muschopauge Lake, Rutland.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13726	Jan. 28	None.	V. slight.	.10	2.70	1.10	.0018	.0244	.0230	.0014	.24	.0050	.0000	.2014	0.9
13968	Mar. 12	Slight.	Slight.	.15	2.50	1.05	.0064	.0308	.0286	.0022	.18	.0100	.0000	.3696	0.5

Odor, very faintly vegetable, and in the last sample also disagreeable. The odor became stronger on heating. —— The samples were collected from the lake.

Microscopical Examination.

No organisms were found in the first sample; in the second, an insignificant number was found.

WATER SUPPLY OF SALEM AND BEVERLY.

The capacity of the sources of water supply of the cities of Salem and Beverly was increased in 1895 by the construction of a reservoir on Longham Brook and a conduit line to convey the water from this reservoir to Wenham Lake. The area of the Longham Brook Reservoir is 43 acres, and its capacity about 55,000,000 gallons. It is long and narrow, its length being 6,500 feet and its average width a little less than 300 feet. Its greatest depth is about 8.5 feet. The area flowed contained considerable meadow land, and was prepared for the storage of water by clearing away the trees and bushes, but the soil was not removed. The drainage area of Longham Brook, above the dam, is about 3.3 square miles, and it contains a small population.

The pipe leading from the reservoir to Wenham Lake is 36 inches in diameter and 4,900 feet in length. Its upper end is 5 feet below the high-water mark of Wenham Lake. It discharges into the lake at a point about 200 feet from the easterly shore, near the outlet, and

7 feet below high water. At the time of introducing water from the Longham Brook Reservoir into Wenham Lake, Jan. 23, 1895, the water in the lake was 19.27 feet below high-water mark, and on May 18, 1895, the reservoir became full for the first time since April 29, 1891.

Analyses of samples of water from Wenham Lake and Longham Brook Reservoir are given below.

As will be seen by the table of averages by years, the average color of the water in Wenham Lake in 1895 was much greater than in previous years.

Chemical Examination of Water from Wenham Lake, in Beverly and Wenham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13627	Jan. 8	Slight.	Slight.	.20	7.50	1.85	.0002	.0152	.0112	.0040	.85	.0050	.0000	.1537	3.8
13805	Feb. 12	V. slight.	V. slight.	.20	7.45	1.70	.0058	.0154	.0134	.0020	.86	.0100	.0000	.2600	3.6
13960	Mar. 11	Slight.	Slight.	.15	7.35	1.50	.0036	.0122	.0104	.0018	.89	.0150	.0000	.2464	3.5
14115	Apr. 9	Slight.	Cons.	.22	7.05	1.90	.0068	.0168	.0122	.0046	.77	.0120	.0000	.3080	3.0
14290	May 13	V. slight.	Slight.	.25	6.65	1.85	.0024	.0242	.0182	.0060	.82	.0050	.0002	.4384	2.7
14450	June 11	Slight.	Cons.	.25	6.50	2.50	.0030	.0190	.0168	.0022	.80	.0030	.0002	.4290	3.0
14630	July 16	Slight.	Cons.	.27	6.60	2.55	.0010	.0218	.0176	.0042	.80	.0070	.0002	.2340	2.9
14836	Aug 13	Distinct, green.	Slight, green.	.18	5.80	1.90	.0022	.0176	.0154	.0022	.82	.0050	.0001	.3744	2.7
15129	Sept. 10	Distinct.	Slight.	.25	6.85	2.15	.0000	.0172	.0134	.0038	.84	.0000	.0001	.3510	2.7
15335	Oct. 9	V. slight.	Slight.	.15	6.70	2.10	.0002	.0174	.0154	.0020	.79	.0030	.0000	.2792	3.0
15521	Nov. 12	Distinct.	Slight,	.20	6.40	1.80	.0026	.0196	.0168	.0028	.74	.0030	.0001	.2808	2.9
15708	Dec. 10	Slight.	Slight.	.20	6.20	1.80	.0034	.0164	.0152	.0012	.76	.0030	.0002	.2847	2.9
Av.	....	....	....	.21	6.75	1.97	0026	.0177	.0146	.0031	.81	.0059	.0001	.3033	3.1

Averages by Years.

-	1887*	-	-	.05	4.73	0.82	.0025	.0135	-	-	.72	.0019	-	-	-
-	1888	-	-	.05	4.67	0.97	.0020	.0146	-	-	.73	.0058	.0001	-	-
-	1889	-	-	.06	4.23	1.05	.0014	.0173	.0138	.0035	.72	.0052	.0002	-	-
-	1890	-	-	.05	4.57	0.90	.0016	.0154	.0125	.0029	.74	.0104	.0001	-	2.5
-	1891	-	-	.07	4.70	1.12	.0006	.0147	.0113	.0034	.72	.0125	.0000	-	1.9
-	1892	-	-	.03	4.85	1.10	.0016	.0137	.0103	.0034	.75	.0077	.0000	-	2.2
-	1893	-	-	.04	5.49	1.26	.0033	.0130	.0100	.0030	.77	.0055	.0001	.1605	2.6
-	1894	-	-	.07	6.69	1.53	.0030	.0148	.0114	.0034	.82	.0023	.0001	.1366	3.0
-	1895	-	-	.21	6.75	1.97	.0026	.0177	.0146	.0031	.81	.0059	.0001	.3033	3.1

* June to December.

NOTE to analyses of 1895: Odor, generally vegetable, rarely none.—— The first two samples were collected from faucets at the pumping station, and the others from the lake.

For monthly record of height of water in this lake, see page 296.

SALEM AND BEVERLY.

Microscopical Examination of Water from Wenham Lake, in Beverly and Wenham.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	14	14	10	14	12	17	15	11	10	13	12
Number of sample,	13627	13805	13960	14115	14290	14450	14630	14836	15129	15335	15521	15708
PLANTS.												
Diatomaceæ,	**1,024**	**190**	**120**	**316**	**781**	**246**	**181**	**1,450**	**134**	**457**	**1,048**	**344**
Asterionella,	334	168	104	180	296	44	0	940	44	24	120	136
Cyclotella,	28	17	12	20	264	100	0	2	0	8	0	68
Fragilaria,	2	0	0	0	4	0	0	8	10	22	0	0
Melosira,	0	0	0	88	0	2	0	0	0	23	120	57
Stephanodiscus,	0	0	0	3	1	0	0	0	0	0	60	0
Synedra,	0	1	0	2	0	2	1	0	0	0	0	19
Tabellaria,	660	4	4	23	216	98	180	500	80	380	748	64
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**9**	**95**	**152**	**34**	**57**	**3**	**0**
Anabæna,	0	0	0	0	0	9	80	144	33	45	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	7	2	0
Clathrocystis,	0	0	0	0	0	0	11	8	1	0	0	0
Cœlosphærium,	0	0	0	0	0	0	4	0	0	5	1	0
Algæ,	**9**	**0**	**0**	**1**	**8**	**36**	**281**	**7**	**74**	**37**	**6**	**13**
Chlorococcus,	0	0	0	0	0	0	0	0	2	5	5	0
Cœlastrum,	0	0	0	0	0	0	0	0	0	0	0	12
Protococcus,	9	0	0	0	0	0	280	7	70	30	0	0
Raphidium,	0	0	0	0	8	35	1	0	0	0	1	1
Staurastrum,	0	0	0	1	0	1	0	0	2	2	0	0
Fungi, Crenothrix,	**0**	**0**	**0**	**76**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**
ANIMALS.												
Rhizopoda, Difflugia,	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**2**	**9**	**5**	**17**	**211**	**44**	**108**	**0**	**16**	**102**	**31**	**2**
Dinobryon,	0	0	0	0	0	40	80	0	0	90	0	0
Dinobryon cases,	0	3	2	7	204	3	28	0	16	5	0	0
Mallomonas,	0	0	0	1	0	0	0	0	0	5	2	0
Monas,	pr.	0	0	1	0	0	0	0	0	0	0	0
Peridinium,	0	0	1	3	1	0	0	0	0	0	1	0
Trachelomonas,	2	6	2	5	6	1	0	0	0	2	28	2
Vermes,	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**0**
Anurea,	0	0	0	1	0	0	0	0	1	0	1	0
Rotatorian ova,	0	0	0	0	1	0	0	0	0	1	0	0
Miscellaneous,	**0**	**0**	**0**	**0**	**0**	**0**	**.08**	**.04**	**0**	**0**	**8**	**0**
Acarina,	0	0	0	0	0	0	.08	.04	0	0	.02	0
Zoöglœa,	0	0	0	0	0	0	0	0	0	0	8	0
TOTAL,	1,035	199	125	413	1,001	338	665	1,609	259	654	1,097	359

SALEM AND BEVERLY.

Chemical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13655	Jan. 14	V. slight.	V. slight.	1.00	5.10	3.20	.0074	.0270	.0254	.0016	.89	.0080	.0000	0.8966	1.3
13804	Feb. 12	V. slight.	Slight.	1.35	6.95	2.40	.0102	.0226	.0212	.0014	.99	.0220	.0001	1.2800	1.9
13959	Mar. 11	Distinct, clayey.	Cons.	0.80	4.95	2.20	.0164	.0286	.0268	.0018	.58	.0100	.0001	0.9317	1.3
14114	Apr. 9	Distinct, milky.	Cons.	0.83	4.90	2.20	.0008	.0320	.0288	.0032	.69	.0080	.0001	0.8431	1.1
14289	May 13	Slight.	Cons.,	2.40	8.20	4.25	.0020	.0572	.0484	.0088	.92	.0050	.0000	2.2910	2.1
Av.	....	....	....	1.28	6.02	2.85	.0074	.0335	.0301	.0034	.81	.0106	.0001	1.0485	1.5

Odor, vegetable and generally unpleasant. —— The first and last two samples were collected from the reservoir, and the others from the 36-inch pipe which conveys water from this reservoir to Wenham Lake.

Microscopical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham.

[Number of organisms per cubic centimeter.]

	1895. Jan.	1895. Feb.	1895. Mar.	1895. Apr.	1895. May.
Day of examination,	15	14	13	10	14
Number of sample,	13655	13804	13959	14114	14289
PLANTS.					
Diatomaceæ,	**6**	**11**	**1**	**32**	**158**
Asterionella,	3	1	0	0	0
Epithemia,	0	1	0	1	4
Gomphonema,	0	0	0	3	0
Melosira,	0	0	0	4	0
Meridion,	3	4	1	12	0
Navicula,	0	pr.	0	0	2
Synedra,	0	3	0	11	152
Tabellaria,	0	2	0	1	0
Algæ, Zoöspores,	**0**	**0**	**2**	**8**	**0**
Fungi,	**2**	**1**	**1,025**	**6**	**4,800**
Cladothrix,	0	0	25	0	0
Crenothrix,	2	1	0	6	4,800
Molds,	0	0	1,000	0	0

SALEM AND BEVERLY.

Microscopical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham — Concluded.

[Number of organisms per cubic centimeter.]

	1895.				
	Jan.	Feb.	Mar.	Apr.	May.
ANIMALS.					
Infusoria,	4	1	0	14	44
Ciliated infusorian,	0	0	0	0	2
Dinobryon,	0	0	0	8	14
Euglena,	1	0	0	0	0
Monas,	0	0	0	2	0
Peridinium,	3	1	0	1	14
Synura,	0	0	0	3	0
Trachelomonas,	0	0	0	0	14
Miscellaneous, Zoöglœa,	0	36	0	0	0
TOTAL,	12	49	1,028	60	5,002

Table showing Heights of Water in Wenham Lake on the First of Each Month in 1895.

[NOTE. — High-water mark is 30 17 feet.]

DATE.	Height of Water.	DATE.	Height of Water.
1895.	Feet.	1895.	Feet.
Jan. 1,	19.17	July 1,	28.90
Feb. 1,	21.56	Aug. 1,	27.98
March 1,	22.21	Sept. 1,	27.08
April 1,	26.73	Oct. 1,	26.04
May 1,	29.50	Nov. 1,	26.08
June 1,	29.79	Dec. 1,	27.50

WATER SUPPLY OF SAUGUS.

(See *Lynn.*)

Water Supply of Sharon.

The works of the Sharon Water Company were purchased by the town Oct. 3, 1895.

Chemical Examination of Water from the Well of the Sharon Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14545	June 26	None.	None.	.00	10.00	.0004	.0002	.97	.1840	.0000	.0000	2.9	.0000
14581	July 8	None.	None.	.00	8.70	.0000	.0000	.98	.2000	.0000	.0000	3.1	.0000

Averages by Years.

-	1887*	-	-	.00	8.30	.0000	.0006	0.85	.1709	-	-	-	-
-	1888†	-	-	.00	7.55	.0001	.0008	0.81	.2130	.0001	-	-	-
-	1892‡	-	-	.00	8.45	.0000	.0001	0.94	.2500	.0000	-	2.9	.0000
-	1893§	-	-	.00	10.70	.0000	.0000	0.91	.3750	.0000	.0158	2.8	.0100
-	1894‖	-	-	.00	9.20	.0000	.0000	1.00	.2500	.0000	.0000	3.0	.0200
-	1895¶	-	-	.00	9.35	.0002	.0001	0.98	.1920	.0000	.0000	3.0	.0000

* June to December. † January to May. ‡ March and September.
§ August. ‖ July. ¶ June and July.

Note to analyses of 1895: Odor, none.——The samples were collected from a faucet at the pumping station while pumping.

Microscopical Examination.

No organisms were found in the first sample; in the last sample an insignificant number was found.

Sheffield.

The advice of the State Board of Health to H. S. Andrews and others, of Sheffield, relative to taking the water of certain springs in that town for a public water supply may be found on page 46 of this volume. The analyses of samples of water collected during the investigation of the proposed sources of supply are given below.

Chemical Examination of Water from Various Sources in Sheffield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1894.														
13583	Dec. 31	None.	Cons.	.00	3.05	0.40	.0002	.0026	.0016	.0010	.07	.0030	.0000	.0000	1.7
	1895.														
13617	Jan. 7	Slight.	Cons., earthy.	.25	3.70	1.20	.0000	.0204	.0038	.0166	.09	.0030	.0000	.2223	1.6
13618	Jan. 7	Slight.	Cons., earthy.	.20	4.75	1.10	.0008	.0188	.0068	.0120	.10	.0070	.0000	.2184	2.9
13616	Jan. 7	Slight.	Cons., earthy.	.50	7.90	2.10	.0034	.0224	.0160	.0064	.12	.0080	.0000	.5499	4.7
13615	Jan. 7	V. slight.	Cons.	.75	7.95	2.60	.0058	.0252	.0236	.0016	.13	.0180	.0001	.7839	4.7

Odor of the first sample, none; of the others, very faintly vegetable. On heating, the odor of No. 13615 became decidedly vegetable and unpleasant.——The samples were collected as follows: No. 13583, from Smith's spring, near the junction of two brooks above the road from Sheffield to Hartsville; No. 13617, from Clark's Brook, just below the junction of three small brooks, a short distance north of Smith's spring; No. 13618, from Pool Brook, below the springs and just above the road to Hartsville; No. 13616, from Iron Brook, just above Three-mile Pond; No. 13615, from Iron Brook, below Three-mile Pond and just below a small mill-pond furnishing power for a saw-mill.

Microscopical Examination.

The total number of organisms per cubic centimeter found in these samples was as follows: No. 13583, 1; No. 13617, 19; No. 13618, 18; No. 13616, 24; No. 13615, 55.

Shirley.

The advice of the State Board of Health to the town of Shirley relative to taking water from Leatherboard Pond in that town as a public water supply may be found on pages 46 and 47 of this volume. The results of analyses of samples of water from several sources in the town, collected during the investigation of proposed sources of supply, are given below.

SHIRLEY.

Chemical Examination of Water from Turner's Pond, Fort Pond, Bow Brook and the Shirley Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
15542	Nov. 13	Distinct.	Cons., fibrous.	.15	1.60	1.10	.0008	.0360	.0306	.0054	.14	.0060	.0001	.4095	0.0
15545	Nov. 13	Distinct, green.	Slight, yellow.	.12	3.45	1.60	.0036	.0284	.0134	.0150	.19	.0050	.0000	.1950	0.9
15543	Nov. 13	Distinct, green.	Slight.	.30	3.65	1.10	.0010	.0140	.0120	.0020	.19	.0050	.0001	.3744	1.1
15544	Nov. 13	Distinct.	Slight.	.48	4.35	1.85	.0002	.0152	.0118	.0034	.19	.0030	.0000	.5086	0.9
15663	Dec. 3	Distinct.	Slight.	.67	4.35	1.95	.0056	.0242	.0202	.0040	.24	.0000	.0000	.7722	1.3

Odor of the first three and last samples, faintly vegetable; of the fourth sample, distinctly vegetable and mouldy. —— The samples were collected as follows: No. 15542, from Turner's Pond, near the easterly shore; No. 15545, from Fort Pond, at its outlet; No. 15543, from Bow Brook, about a mile below Turner's Pond and just above Leatherboard Pond; No. 15544, from Leatherboard Pond, a small mill-pond on Bow Brook, at its outlet; No. 15663, from Shirley reservoir, near the dam.

Microscopical Examination of Water from Turner's Pond, Fort Pond, Bow Brook and the Shirley Reservoir.

[Number of organisms per cubic centimeter.]

	1895.				
	Nov.	Nov.	Nov.	Nov.	Dec.
Day of examination,	15	15	15	16	4
Number of sample,	15542	15545	15543	15544	15663
PLANTS.					
Diatomaceæ,	**2**	**684**	**164**	**13**	**51**
Asterionella,	0	4	3	0	21
Cyclotella,	2	36	0	0	0
Diatoma,	0	1	0	6	0
Fragilaria,	0	0	0	2	0
Melosira,	0	640	160	0	0
Navicula,	0	0	1	0	1
Synedra,	0	0	0	5	27
Tabellaria,	0	3	0	0	2
Cyanophyceæ, Oscillaria,	**0**	**1,160**	**0**	**0**	**0**
Algæ,	**52**	**0**	**584**	**1**	**1**
Arthrodesmus,	8	0	0	1	0
Chlorococcus,	14	0	0	0	0
Conferva,	0	0	584	0	0
Raphidium,	24	0	0	0	1
Spirogyra,	2	0	0	0	0
Staurastrum,	4	0	0	0	0
Fungi, Crenothrix,	**0**	**2**	**1**	**0**	**1**

SHIRLEY.

Microscopical Examination of Water from Turner's Pond, Fort Pond, Bow Brook and the Shirley Reservoir — Concluded.

[Number of organisms per cubic centimeter.]

	1895. Nov.	Nov.	Nov.	Nov.	Dec.
ANIMALS.					
Infusoria,	**2**	**0**	**0**	**48**	**307**
Dinobryon,	0	0	0	0	306
Dinobryon cases,	2	0	0	48	0
Mallomonas,	0	0	0	0	1
Miscellaneous, Zoöglœa,	**120**	**80**	**0**	**0**	**0**
TOTAL,	176	1,926	749	62	360

Water Supply of Somerville.

(See *Boston, Mystic Works.*)

Chemical Examination of Water from a Spring at Winter Hill, Somerville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
13926	1895. Mar. 5	None.	None.	.00	25.80	.0000	.0002	2.20	.5500	.0000	.0269	15.2	.0000

Odor, none.—— The sample was collected from an iron pipe set in a spring near the Winter Hill station on the Boston & Maine Railroad in Somerville.

Microscopical Examination.

No organisms.

Spencer.

Chemical Examination of Water from a Stream flowing from Brook's Pond, Spencer.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation. Total.	Loss on Ignition.	Ammonia. Free.	Albuminoid. Total.	Dissolved.	Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
14360	1895. May 23	Distinct.	Slight.	.30	2.60	0.85	.0004	.0158	.0114	.0044	.17	.0000	.0000	.4279	0.9

Odor, very faintly vegetable, becoming much stronger on heating.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 16; *Cyclotella*, 3; *Himantidium*, 1; *Melosira*, 35; *Synedra*, 3; *Tabellaria*, 160. Cyanophyceæ, *Anabæna*, 7. Algæ, *Arthrodesmus*, 1; *Raphidium*, 4; *Scenedesmus*, 1. Infusoria, *Dinobryon cases*, 96; *Peridinium*, 1; *Trachelomonas*, 1; *Vorticella*, 3. Vermes, *Polyarthra*, 1. Total, 333.

Water Supply of Springfield.

Chemical Examination of Water from the Receiving Basin of the Springfield Water Works, at Ludlow.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13639	Jan. 10	Slight.	V. slight.	.60	4.00	1.80	.0022	.0162	.0156	.0006	.19	.0080	.0002	.5304	1.6
13796	Feb. 11	Slight.	Slight.	.35	3.85	1.50	.0068	.0182	.0158	.0024	.21	.0070	.0000	.4240	1.4
13953	Mar. 11	Slight.	Slight.	.45	3.90	1.60	.0034	.0172	.0148	.0024	.17	.0100	.0000	.5043	0.8
14108	Apr. 8	Slight.	Slight.	.50	3.50	1.45	.0016	.0156	.0120	.0036	.14	.0050	.0000	.4759	0.9
14268	May 8	Distinct.	Cons.	.55	3.75	1.65	.0010	.0172	.0128	.0044	.15	.0000	.0000	.5120	1.4
14445	June 10	Slight.	Cons.	.63	4.05	2.05	.0016	.0238	.0218	.0020	.12	.0050	.0003	.6384	1.4
14620	July 15	Slight.	Cons.	.50	3.95	1.60	.0016	.0226	.0194	.0032	.16	.0070	.0000	.4914	1.5
14811	Aug. 12	Slight.	Cons., brown.	.30	3.70	1.75	.0016	.0204	.0150	.0054	.20	.0000	.0000	.3900	1.6
15106	Sept. 9	Decided, green.	Cons., green.	.25	3.65	1.20	.0002	.0346	.0198	.0148	.19	.0000	.0000	.3237	1.9
15337	Oct. 9	V. slight.	Slight, green.	.30	3.95	1.60	.0004	.0366	.0198	.0168	.22	.0050	.0000	.4306	1.4
15510	Nov. 11	Slight.	Slight.	.75	4.75	2.00	.0012	.0198	.0164	.0034	.28	.0100	.0000	.7293	1.4
15694	Dec. 9	V. slight.	V. slight.	.50	3.25	1.10	.0008	.0128	.0114	.0014	.12	.0030	.0000	.5132	0.9
Av.	....	....	....	.47	3.86	1.61	.0019	.0212	.0162	.0050	.18	.0050	.0000	.4969	1.3

Averages by Years.

-	1891	-	-	.31	3.27	1.20	.0011	.0225	.0147	.0078	.09	.0049	.0001	-	1.0
-	1892	-	-	.44	3.79	1.39	.0004	.0164	.0127	.0037	.14	.0089	.0001	-	1.3
-	1893	-	-	.49	3.76	1.39	.0009	.0204	.0146	.0058	.15	.0026	.0001	.5132	1.2
-	1894	-	-	.49	3.68	1.42	.0010	.0196	.0151	.0045	.16	.0027	.0000	.4635	1.6
-	1895	-	-	.47	3.86	1.61	.0019	.0212	.0162	.0050	.18	.0050	.0000	.4969	1.3

Note to analyses of 1895: Odor, vegetable, occasionally mouldy.——The samples were collected in the gate-house. A portion of the water received into this basin comes from Ludlow Reservoir.

SPRINGFIELD.

Microscopical Examination of Water from the Receiving Basin of the Springfield Water Works at Ludlow.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	13	13	9	9	11	16	13	11	10	13	10
Number of sample,	13639	13796	13953	14108	14268	14445	14620	14811	15106	15337	15510	15694
PLANTS.												
Diatomaceæ,	**7**	**26**	**19**	**36**	**210**	**121**	**378**	**160**	**629**	**900**	**60**	**19**
Asterionella,	0	20	8	5	17	13	6	20	8	0	20	0
Cocconema,	0	0	0	0	7	0	0	0	0	0	0	0
Cyclotella,	0	0	0	1	0	1	4	0	4	0	0	0
Cymbella,	0	0	0	1	2	1	5	0	12	0	2	0
Fragilaria,	0	0	0	0	0	0	320	100	524	900	2	5
Melosira,	0	3	4	12	125	38	20	30	47	0	18	0
Meridion,	2	0	0	4	0	0	0	0	0	0	0	1
Navicula,	1	0	2	2	9	8	13	4	6	0	6	2
Surirella,	1	1	0	0	2	2	0	0	1	0	0	1
Synedra,	2	2	4	10	48	48	8	4	2	0	7	4
Tabellaria,	1	0	1	1	0	10	2	2	25	0	5	6
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**14**	**456**	**1,800**	**0**	**0**
Anabæna,	0	0	0	0	0	6	0	14	450	1,050	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	6	750	0	0
Algæ,	**0**	**1**	**5**	**3**	**18**	**8**	**61**	**382**	**370**	**100**	**6**	**0**
Chlorococcus,	0	0	0	0	0	0	0	0	180	0	5	0
Cœlastrum,	0	0	0	0	0	0	36	0	0	0	0	0
Desmidium,	0	0	0	0	6	0	0	0	0	0	0	0
Glœocapsa,	0	0	0	0	0	0	0	68	0	0	0	0
Pediastrum,	0	0	0	0	5	0	2	4	2	0	0	0
Protococcus,	0	0	0	0	0	0	15	260	0	0	0	0
Raphidium,	0	0	0	0	0	0	2	12	12	0	0	0
Scenedesmus,	0	1	0	0	4	1	1	32	4	50	1	0
Staurastrum,	0	0	0	0	0	7	4	6	8	50	0	0
Staurogenia,	0	0	0	0	0	0	1	0	164	0	0	0
Zoöspores,	0	0	5	3	3	0	0	0	0	0	0	0
Fungi, Crenothrix,	**2**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**9**	**0**
ANIMALS.												
Infusoria,	**1**	**78**	**43**	**120**	**258**	**1**	**94**	**26**	**66**	**0**	**3**	**0**
Bursaria,	0	50	0	0	0	0	0	0	0	0	0	0
Dinobryon,	0	7	1	24	0	0	74	0	30	0	0	0
Dinobryon cases,	0	0	32	84	256	0	0	6	0	0	0	0
Mallomonas,	0	0	0	1	0	1	0	11	0	0	0	0
Peridinium,	1	0	10	11	1	0	0	4	0	0	1	0
Trachelomonas,	0	1	0	0	1	0	20	5	36	0	2	0
Uroglena,	0	20	0	0	0	0	0	0	0	0	0	0
Vermes,	**0**	**10**	**1**	**0**	**2**	**1**	**0**	**0**	**2**	**0**	**0**	**0**
Anurea,	0	10	0	0	0	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	0	0	0	0	2	0	0	0
Rotifer,	0	0	1	0	2	1	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**56**	**0**	**316**	**0**	**0**	**30**	**0**	**0**	**100**	**0**
TOTAL,	10	115	125	159	805	137	533	613	1,523	2,800	178	19

SPRINGFIELD.

Chemical Examination of Water from Ludlow Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13611	Jan. 7	Slight.	Slight.	.43	3.65	1.55	.0016	.0296	.0240	.0056	.20	.0000	.0000	.4407	1.3
13710	Jan. 24	Slight.	Slight.	.40	3.40	1.65	.0012	.0308	.0246	.0062	.23	.0030	.0000	.5174	0.9
13795	Feb. 11	Slight.	Slight.	.42	4.10	1.60	.0132	.0308	.0258	.0050	.23	.0030	.0000	.5824	1.4
13952	Mar. 11	Slight, green.	Slight.	.25	2.95	1.10	.0058	.0214	.0130	.0084	.15	.0070	.0000	.3503	0.8
14107	Apr. 8	Slight.	Slight.	.28	3.40	1.50	.0052	.0224	.0176	.0048	.15	.0030	.0000	.3811	1.1
14267	May 8	Slight.	Cons.	.20	3.15	1.70	.0004	.0186	.0166	.0020	.16	.0000	.0000	.3411	1.1
14444	June 10	Slight.	Cons.	.25	3.10	1.60	.0016	.0220	.0188	.0032	.17	.0030	.0000	.4028	0.9
14619	July 15	Slight.	Cons.	.28	3.10	1.90	.0000	.0266	.0186	.0080	.15	.0070	.0000	.3744	1.1
14705	July 24	Distinct.	Cons., green.	.40	3.20	1.20	.0004	.0232	.0162	.0070	.23	.0030	.0000	.3773	1.3
14810	Aug. 12	Distinct, green.	Cons., green.	.23	3.30	1.70	.0012	.0250	.0198	.0052	.18	.0020	.0000	.2340	1.4
14923	Aug. 28	V. slight.	Cons.	.18	3.35	1.65	.0010	.0250	.0188	.0062	.20	.0030	.0000	.3276	1.2
15108	Sept. 9	Decided, green.	Cons., green.	.20	3.60	1.45	.0000	.0440	.0224	.0216	.21	.0000	.0000	.3994	1.3
15232	Sept. 23	Slight.	Cons., green.	.23	3.25	1.60	.0022	.0416	.0244	.0172	.18	.0070	.0000	.4524	0.8
15336	Oct. 9	Distinct.	Slight, green	.20	3.10	1.45	.0000	.0714	.0212	.0502	.18	.0000	.0000	.3900	1.3
15412	Oct. 22	Decided, green.	Cons., green.	.23	3.20	1.80	.0000	.0582	.0232	.0350	.20	.0030	.0000	.4017	0.8
15509	Nov. 11	Distinct, green.	Cons., yellow.	.30	3.75	1.60	.0016	.0486	.0242	.0244	.30	.0050	.0000	.4976	1.1
15609	Nov. 25	Decided, green.	Slight.	.35	3.15	1.65	.0002	.0400	.0208	.0192	.15	.0030	.0001	.4992	1.1
15695	Dec. 9	Slight.	Slight.	.38	3.55	1.60	.0010	.0344	.0218	.0126	.13	.0030	.0001	.4914	0.9
15799	Dec. 23	Distinct.	Slight.	.30	3.35	1.50	.0048	.0276	.0180	.0096	.15	.0000	.0000	.4350	0.9
Av.*	....	....	....	.29	3.35	1.55	.0028	.0315	.0201	.0114	.18	.0030	.0000	.4147	1.1

Averages by Years.

-	1876-77†	-	-	-	4.86	-	.0139	.0426	.0296	.0130	-	-	-	-	-
-	1887‡	-	-	.24	3.63	1.65	.0030	.0486	-	-	.15	.0019	-	-	-
-	1888	-	-	.13	2.91	1.20	.0019	.0332	-	-	.12	.0047	.0001	-	-
-	1889	-	-	.11	2.42	1.07	.0028	.0461	.0237	.0224	.10	.0033	.0002	-	-
-	1890	-	-	.15	2.96	1.54	.0029	.0387	.0210	.0177	.10	.0065	.0001	-	0.9
-	1891	-	-	.20	3.00	1.42	.0050	.0425	.0228	.0197	.09	.0050	.0001	-	0.8
-	1892§	-	-	.25	3.41	1.41	.0006	.0277	.0189	.0088	.13	.0049	.0001	-	1.0
-	1893‖	-	-	.47	4.11	2.03	.0011	.0375	.0259	.0116	.14	.0019	.0001	.5779	1.2
-	1894	-	-	.37	3.39	1.47	.0009	.0221	.0165	.0056	.16	.0018	.0000	.4185	1.1
-	1895	-	-	.29	3.35	1.55	.0028	.0315	.0201	.0114	.18	.0030	.0000	.4147	1.1

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† These analyses were made by Prof. William R. Nichols, for the city of Springfield, from samples collected about once a week, between July 1, 1876, and Sept. 30, 1877.

‡ June to December. § January to September. ‖ May to December.

NOTE to analyses of 1895: Odor, vegetable and mouldy or unpleasant, becoming stronger during the latter half of the year.—The samples were collected from the reservoir 2 or 3 feet beneath the surface.

For monthly record of height of water, see page 306.

SPRINGFIELD.

Microscopical Examination of Water from Ludlow Reservoir, Springfield.

The number of organisms found in the samples of water collected from Ludlow reservoir in the months of January, February and June was insignificant. In March, April and May the samples contained respectively 3,850, 1,065 and 1,590 organisms per cubic centimeter, consisting almost wholly of Dinobryon or Dinobryon cases. The results of the microscopical examination of samples collected during the remainder of the year are given in the following table: —

Microscopical Examination of Water from Ludlow Reservoir.

[Number of organisms per cubic centimeter.]

	1895.											
	July.	July.	Aug.	Aug.	Sept.	Sept	Oct.	Oct.	Nov.	Nov.	Dec.	Dec.
Day of examination,	16	26	13	29	11	25	10	23	13	27	10	26
Number of sample,	14619	14705	14810	14923	15108	15232	15336	15412	15509	15609	15695	15799
PLANTS.												
Diatomaceæ,	**2,079**	**4,618**	**25**	**323**	**466**	**422**	**500**	**800**	**1,000**	**2,400**	**233**	**12**
Asterionella,	64	9	0	29	5	0	0	0	400	0	0	2
Cyclotella,	1	0	0	0	0	36	0	0	0	0	0	0
Fragilaria,	1,960	0	25	292	460	386	500	0	600	0	233	0
Melosira,	50	2	0	0	0	0	0	0	0	0	0	0
Synedra,	4	7	0	0	0	0	0	800	0	2,400	0	10
Tabellaria,	0	4,600	0	2	1	0	0	0	0	0	0	0
Cyanophyceæ,	**0**	**40**	**43**	**48**	**1,001**	**1,144**	**4,300**	**2,550**	**1,400**	**1,300**	**133**	**21**
Anabæna,	0	40	42	48	1,000	300	3,550	2,550	1,150	1,300	112	13
Chroöcoccus,	0	0	0	0	0	832	750	0	250	0	21	8
Microcystis,	0	0	1	0	1	12	0	0	0	0	0	0
Algæ,	**179**	**249**	**455**	**72**	**717**	**32**	**50**	**1,300**	**300**	**100**	**16**	**16**
Chlorococcus,	0	0	0	0	320	0	0	0	0	0	0	0
Cœlastrum,	80	0	0	0	0	6	0	0	0	0	0	0
Desmidium,	0	0	0	0	0	0	0	0	50	0	0	0
Glœocapsa,	0	0	0	2	0	0	0	500	0	0	0	0
Pediastrum,	3	2	3	0	1	0	0	0	50	0	0	0
Protococcus,	52	220	430	33	195	0	0	450	0	0	0	0
Raphidium,	3	11	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	2	3	20	8	1	16	0	100	0	0	1	3
Staurastrum,	36	13	2	8	24	6	0	250	200	100	9	13
Staurogenia,	3	0	0	21	176	4	0	0	0	0	6	0
Zoöspores,	0	0	0	0	0	0	50	0	0	0	0	0
ANIMALS.												
Rhizopoda, Arcella,	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**50**	**0**	**0**
Infusoria,	**997**	**33**	**159**	**160**	**58**	**4**	**150**	**50**	**450**	**150**	**5**	**40**
Dinobryon,	940	9	65	2	0	0	0	0	0	0	0	21
Dinobryon cases,	0	0	69	0	0	0	0	0	0	0	0	0
Euglena,	0	0	0	0	1	0	0	0	0	0	0	0
Mallomonas,	0	0	3	0	0	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	100	0	150	150	0	0
Peridinium,	1	0	11	22	1	0	0	0	0	0	3	19
Trachelomonas,	52	24	11	136	56	4	50	50	300	0	1	0
Uroglena,	0	0	0	0	0	0	0	0	0	0	1	0
Vorticella,	4	0	0	0	0	0	0	0	0	0	0	0

Microscopical Examination of Water from Ludlow Reservoir — Concluded.

[Number of organisms per cubic centimeter.]

	1895.											
	July.	July.	Aug.	Aug.	Sept.	Sept.	Oct.	Oct.	Nov.	Nov.	Dec.	Dec.
ANIMALS — Con.												
Vermes,	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**6**
Anurea,	0	1	0	0	0	0	0	0	0	0	1	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0	0	1	3
Rotifer,	0	0	0	0	0	0	0	0	0	0	0	3
Crustacea,	**.20**	**.06**	**.14**	**0**	**.02**	**0**	**0**	**.04**	**0**	**0**	**0**	**0**
Cyclops,	0	.06	.08	0	0	0	0	.04	0	0	0	0
Daphnia,	.20	0	.06	0	.02	0	0	0	0	0	0	0
Miscellaneous,	**0**	**0**	**.10**	**28**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120**
Acarina,	0	0	.10	.06	0	0	0	0	0	0	0	0
Zoöglœa,	0	0	0	28	0	0	0	0	0	0	0	120
TOTAL,	3,256	4,941	682	631	2,242	1,602	5,000	4,700	3,150	4,000	389	215

Chemical Examination of Water from a Faucet in Springfield supplied from the Springfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
13640	1895. Jan. 10	Slight.	V. slight.	.60	3.85	1.40	.0016	.0126	.0126	.0000	.22	.0080	.0002	.4992	1.6

Odor, faintly vegetable, becoming stronger on heating. —— The sample was collected from a faucet at the office of the water works.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 1. Infusoria, *Peridinium*, 1. Total, 2.

SPRINGFIELD.

Table showing Heights of Water in Ludlow Reservoir on the First of Each Month in 1895.

NOTE. — Height of rollway, 28.1 feet above bottom of reservoir.

Date.	Height of Water above Bottom of Reservoir.	Date.	Height of Water above Bottom of Reservoir.
1895.	Feet.	1895.	Feet.
Jan. 1,	15.30	July 1,	17.66
Feb. 1,	17.16	Aug. 1,	17.30
March 1,	16.73	Sept. 1,	16.20
April 1,	18.75	Oct. 1,	15.25
May 1,	18.40	Nov. 1,	13.75
June 1,	18.36	Dec. 1,	13.08

Water Supply of Stockbridge. — Stockbridge Water Company.

Chemical Examination of Water from Lake Averic, Stockbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended		Nitrates.	Nitrites.		
	1895.														
14292	May 13	Slight.	Cons.	.15	5.80	1.50	.0010	.0152	.0144	.0008	.07	.0030	.0000	.2370	4.0
15537	Nov. 12	Decided, green.	Slight.	.12	6.10	1.20	.0004	.0274	.0192	.0082	.06	.0070	.0000	.2746	4.9

Odor of the first sample, none; of the second, decidedly oily. — The samples were collected from the reservoir just beneath the surface.

Microscopical Examination.

No. 14292. Diatomaceæ, *Asterionella*, 11; *Cyclotella*, 1; *Fragilaria*, 1; *Navicula*, 2; *Synedra*, 24. Algæ, *Scenedesmus*, 1. Fungi, *Crenothrix*, 3. Vermes, *Rotifer*, 1. Miscellaneous, *Acarina*, .01; *Zoöglœa*, 3. Total, 47.

No. 15537. Diatomaceæ, *Asterionella*, 7. Algæ, *Volvox*, 20. Fungi, *Crenothrix*, 1. Infusoria, *Peridinium*, 2; *Trachelomonas*, 1. Vermes, *Rotifer*, 1. Total, 32.

Water Supply of Stoneham.

(See *Wakefield*.)

Water Supply of Stoughton.

The advice of the State Board of Health to the town of Stoughton relative to an additional supply of water for the town may be found on pages 47–50 of this volume. Analyses of samples of water collected during the investigation for an additional supply may be found on page 316 of the annual report for 1894.

Chemical Examination of Water from the Stoughton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13725	Jan. 27	None.	None.	.12	3.40	0.80	.0002	.0056	.0044	.0012	.35	.0200	.0000	.1722	0.8
14034	Mar. 24	None.	V. slight.	.12	3.25	0.95	.0002	.0048	.0034	.0014	.35	.0030	.0000	.1655	0.9

Odor, none. A distinctly vegetable odor was developed in the second sample, on heating. —— The first sample was collected from a faucet in the town and the second from a faucet at the pumping station.

Microscopical Examination.

No. 13725. No organisms.

No. 14034. Diatomaceæ, *Diatoma*, 1; *Fragilaria*, 1; *Meridion*, 1; *Navicula*, 1; *Synedra*, 2. Algæ, *Zoöspores*, 1. Fungi, *Crenothrix*, 3; *Molds*, 1. Total, 11.

Water Supply of Swampscott and Nahant. — Marblehead Water Company.

In 1895 the sources of supply of this company were increased by the construction of temporary works for drawing water from a system of ten tubular wells located a short distance east of the Swampscott station, in the angle formed by the main line of the Eastern Division of the Boston & Maine Railroad and the Marblehead Branch. The wells are in the vicinity of a small tributary of Stacy's Brook, which flows through this territory, and are in a line parallel to the main line of the Eastern Division. They are 12 feet apart in the line, and range in depth from 30 to 47 feet. These wells are from 800 to 1,000 feet distant from the wells of the Marblehead Water Company in Paradise Road. Between Aug. 6 and Nov. 2, 1895, about 14,500,000 gallons are said to have been drawn from this source for the supply of the towns.

SWAMPSCOTT AND NAHANT.

Chemical Examination of Water from the Wells of the Marblehead Water Company, Swampscott.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13614	Jan. 7	None.	V. slight.	.03	12.60	.0004	.0030	1.57	.0400	.0000	.0429	6.6	.0030
13775	Feb. 6	Decided, milky.	None.	.20	9.80	.0010	.0054	1.27	.0320	.0000	.1288	4.2	.0020
13931	Mar. 5	Distinct, clayey.	V. slight.	.10	24.80	.0004	.0056	5.55	.1500	.0000	.1401	10.5	.0110
14086	Apr. 2	V. slight, milky.	V. slight, white.	.05	12.50	.0000	.0028	1.34	.0100	.0000	.0731	6.1	.0030
14251	May 6	None.	V. slight.	.05	12.70	.0000	.0020	1.46	.0600	.0000	.0670	5.9	.0020
14417	June 4	V. slight.	V. slight.	.10	11.50	.0002	.0050	1.28	.0420	.0000	.1482	5.1	.0100
14605	July 9	None.	V. slight.	.00	70.90	.0000	.0008	19.30	.1640	.0000	.0276	14.4	.0050
14799	Aug. 6	None.	None.	.00	43.90	.0000	.0012	9.60	.2500	.0000	.0624	16.4	.0050
14989	Sept. 4	None.	None.	.02	81.50	.0000	.0008	24.55	.3300	.0000	.0524	15.2	.0230
15308	Oct. 2	None.	None.	.00	14.90	.0000	.0004	2.00	.1100	.0000	.0000	7.3	.0010
15488	Nov. 6	Slight, rusty.	Slight, rusty.	.18	47.70	.0002	.0070	18.60	.1400	.0000	.2200	16.0	.0130
15685	Dec. 3	Slight, milky.	V. slight.	.23	11.30	.0000	.0054	1.37	.0500	.0000	.2028	4.7	.0080
Av.	....	....	....	.08	29.51	.0002	.0033	6.91	.1148	.0000	.0971	9.4	.0072

Averages by Years.

-	1887*	-	-	.03	23.88	.0032	.0028	2.94	.5302	-	-	-	-
-	1888	-	-	.00	25.16	.0007	.0035	3.26	.4477	.0003	-	-	-
-	1889†	-	-	.00	26.20	.0006	.0033	3.80	.4390	.0002	-	-	-
-	1890‡	-	-	.00	44.00	.0006	.0010	8.30	.6250	.0001	-	21.2	-
-	1891	-	-	.00	38.64	.0018	.0010	7.73	.9909	.0002	-	18.0	-
-	1892	-	-	.00	54.94	.0000	.0010	14.53	.7437	.0000	-	22.0	-
-	1893	-	-	.01	46.42	.0000	.0022	12.12	.4263	.0000	.0747	14.7	.0061
-	1894	-	-	.04	37.84	.0002	.0018	10.52	.2983	.0000	.0506	15.8	.0066
-	1895	-	-	.08	29.51	.0002	.0033	6.91	.1148	.0000	.0971	9.4	.0072

* June to December. † January to May. ‡ October.

NOTE to analyses of 1895: Odor, none, except in June, when it was faintly vegetable and musty. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 53, consisting chiefly of *Crenothrix*.

SWAMPSCOTT AND NAHANT.

Chemical Examination of Water from Tubular Wells a Short Distance East of the Swampscott Railroad Station in Swampscott.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14898	Aug. 21	V. slight, milky.	None.	.01	12.50	.0000	.0000	1.48	.0200	.0060	.0156	5.7	.0100
15181	Sept. 16	None.	None.	.03	12.50	.0000	.0010	1.42	.0150	.0002	.0094	6.1	.0060

Odor, none. —— The samples were collected from a faucet on a pump drawing water from the wells.

Microscopical Examination.

No organisms.

Water Supply of Taunton.

Chemical Examination of Water from Assawompsett Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13711	Jan 24	V. slight.	V. slight.	.45	3.45	1.85	.0004	.0168	.0158	.0010	.53	.0030	.0000	.5451	0.8
13888	Feb. 25	V. slight.	Slight.	.70	4.15	1.95	.0010	.0202	.0188	.0014	.55	.0000	.0000	.7426	0.9
14038	Mar. 25	Slight.	Cons.	.53	3.45	1.50	.0002	.0174	.0146	.0028	.47	.0000	.0000	.5505	0.9
14196	Apr. 22	Slight.	Cons.	.53	3.50	1.80	.0000	.0160	.0136	.0024	.49	.0000	.0000	.6675	0.0
14375	May 27	Slight.	Cons.	.48	3.50	2.25	.0002	.0220	.0202	.0018	.53	.0000	.0000	.5966	0.6
14542	June 25	Distinct.	Cons.	.43	3.70	1.85	.0002	.0190	.0166	.0024	.51	.0000	.0000	.5298	0.6
14730	July 29	V slight.	Cons	.30	3.10	0.90	.0014	.0220	.0174	.0046	.56	.0050	.0000	.5082	0.9
14911	Aug. 26	Slight.	Slight.	.20	2.90	1.10	.0014	.0178	.0142	.0036	.58	.0030	.0000	.4134	0.4
15239	Sept. 23	None.	V. slight.	.08	3.20	1.35	.0002	.0188	.0158	.0030	.56	.0020	.0000	.3900	0.9
15439	Oct. 28	Slight.	Slight.	.15	2.90	1.35	.0004	.0174	.0138	.0036	.54	.0030	.0000	.3526	0.6
15610	Nov. 26	Slight.	Cons.	.18	2.80	1.05	.0002	.0174	.0136	.0038	.51	.0000	.0000	.3098	0.6
15798	Dec. 23	Slight.	Slight.	.25	3.40	1.50	.0010	.0166	.0136	.0030	.50	.0000	.0000	.4327	0.8
Av.	....	....	....	.36	3.34	1.54	.0005	.0185	.0157	.0028	.53	.0013	.0000	.5032	0.7

Averages by Years.

-	1887*	-	-	.45	3.63	1.57	.0005	.0180	-	-	.48	.0015	-	-	-
-	1888†	-	-	.30	4.20	1.35	.0001	.0238	-	-	.45	.0030	.0001	-	-
-	1891‡	-	-	.03	2.80	1.02	.0000	.0157	.0110	.0047	.46	.0025	.0000	-	0.4
-	1894	-	-	.33	3.22	1.26	.0003	.0157	.0132	.0025	.51	.0021	.0000	.4344	0.7
-	1895	-	-	.36	3.34	1.54	.0005	.0185	.0157	.0028	.53	.0013	.0000	.5032	0.7

* June and September. † January and May. ‡ December, two samples.

Note to analyses of 1895: Odor, generally faintly vegetable; sometimes none. In May the odor became distinctly oily on heating. —— The samples were collected from the pond at the intake of the Taunton Water Works.

TAUNTON.

Microscopical Examination of Water from Assawompsett Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	27	27	23	29	26	31	28	26	30	27	26
Number of sample,	13711	13888	14038	14196	14375	14542	14730	14911	15239	15439	15610	15798
PLANTS.												
Diatomaceæ,	**101**	**52**	**166**	**229**	-	**71**	**62**	**21**	**17**	**119**	**50**	**33**
Asterionella,	99	41	88	95	-	46	13	0	8	64	2	0
Cyclotella,	0	0	1	2	-	17	3	0	0	0	3	1
Diatoma,	0	0	1	0	-	0	0	0	0	6	0	0
Melosira,	0	0	9	72	-	4	36	18	9	0	34	0
Navicula,	0	1	3	1	-	0	5	0	0	3	6	0
Synedra,	1	10	52	52	-	4	2	2	0	44	1	28
Tabellaria,	1	0	12	7	-	0	3	1	0	2	4	4
Cyanophyceæ,	**0**	**0**	**0**	**0**	-	**3**	**0**	**3**	**10**	**0**	**0**	**0**
Chroöcoccus,	0	0	0	0	-	0	0	0	10	0	0	0
Microcystis,	0	0	0	0	-	3	0	3	0	0	0	0
Algæ,	**0**	**0**	**15**	**6**	-	**268**	**30**	**79**	**0**	**26**	**0**	**1**
Chlorococcus,	0	0	0	6	-	0	0	0	0	3	0	0
Hyalotheca,	0	0	10	0	-	0	0	0	0	0	0	0
Protococcus,	0	0	5	0	-	268	30	79	0	9	0	0
Raphidium,	0	0	0	0	-	0	0	0	0	14	0	1
Fungi,	**1**	**0**	**0**	**2**	-	**28**	**4**	**0**	**3**	**4**	**2**	**0**
Crenothrix,	1	0	0	2	-	28	4	0	0	0	2	0
Molds,	0	0	0	0	-	0	0	0	3	4	0	0
ANIMALS.												
Infusoria,	**46**	**188**	**120**	**94**	-	**2**	**5**	**16**	**17**	**5**	**0**	**1**
Dinobryon,	32	94	44	0	-	0	0	16	17	0	0	11
Dinobryon cases,	11	92	72	92	-	0	2	0	0	0	0	0
Peridinium,	3	2	4	2	-	1	3	0	0	4	0	0
Trachelomonas,	0	0	0	0	-	1	0	0	0	1	0	0
Vermes, Anurea,	**0**	**0**	**0**	**0**	-	**1**	**1**	**0**	**2**	**1**	**0**	**0**
Crustacea, Cyclops,	**0**	**0**	**0**	**.02**	-	**0**	**0**	**.04**	**0**	**0**	**0**	**0**
Miscellaneous,	**0**	**0**	**0**	**2**	-	**0**	**.02**	**2**	**24**	**100**	**0**	**0**
Acarina,	0	0	0	0	-	0	.02	0	.04	0	0	0
Zoöglœa,	0	0	0	2	-	0	0	2	24	100	0	0
TOTAL,	148	240	301	333	-	373	102	121	73	255	52	45

TAUNTON.

Chemical Examination of Water from Elder's Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13712	Jan. 24	V. slight.	V. slight.	.03	2.65	1.20	.0002	.0150	.0134	.0016	.44	.0030	.0000	.2014	0.5
13889	Feb. 25	V. slight.	Slight.	.05	2.75	0.90	.0000	.0152	.0144	.0008	.49	.0000	.0000	.2291	0.6
14037	Mar. 25	V. slight.	Slight.	.07	2.80	1.30	.0004	.0128	.0116	.0012	.44	.0000	.0000	.2387	0.6
14197	Apr. 22	Slight.	Cons.	.03	2.15	0.85	.0000	.0134	.0120	.0014	.46	.0000	.0000	.2093	0.5
14376	May 27	V. slight.	Cons.	.05	2.75	1.15	.0000	.0232	.0212	.0020	.46	.0000	.0000	.2698	0.5
14541	June 25	Slight.	Slight.	.08	3.05	1.25	.0000	.0156	.0136	.0020	.46	.0000	.0000	.1925	0.5
14729	July 29	V. slight.	Slight.	.05	2.60	0.60	.0000	.0170	.0148	.0022	.49	.0070	.0000	.2618	0.8
14912	Aug. 26	Slight.	Slight.	.05	2.30	0.85	.0000	.0172	.0132	.0040	.46	.0030	.0000	.2028	0.3
15238	Sept. 23	None.	Slight.	.08	2.55	1.00	.0002	.0166	.0148	.0018	.48	.0060	.0000	.2379	0.2
15440	Oct. 28	V. slight.	V. slight.	.08	2.30	0.95	.0000	.0162	.0150	.0012	.48	.0030	.0000	.2262	0.5
15611	Nov. 26	V. slight.	Slight.	.04	2.35	0.65	.0004	.0148	.0134	.0014	.43	.0000	.0000	.1794	0.3
15797	Dec. 23	Slight.	V. slight.	.03	2.60	1.05	.0002	.0166	.0144	.0022	.49	.0000	.0000	.2502	0.3
Av.	....	....	....	.05	2.57	0.98	.0001	.0161	.0143	.0018	.46	.0018	.0000	.2249	0.5

Averages by Years.

-	1887*	-	-	.00	2.50	0.58	.0004	.0130	-	-	.41	.0030	-	-	-
-	1888†	-	-	.05	2.00	0.45	.0000	.0138	-	-	.35	.0000	.0000	-	-
-	1891‡	-	-	.00	2.03	0.90	.0000	.0143	.0120	.0023	.40	.0010	.0001	-	0.3
-	1894	-	-	.04	2.32	0.94	.0004	.0135	.0120	.0015	.42	.0015	.0000	.1668	0.4
-	1895	-	-	.05	2.57	0.98	.0001	.0161	.0143	.0018	.46	.0018	.0000	.2249	0.5

* September. † May. ‡ December, two samples.

NOTE to analyses of 1895: Odor, generally faintly vegetable, sometimes none. The odor generally became stronger on heating. —— The samples were collected from the pond near the gate-house of the Taunton Water Works.

TAUNTON.

Microscopical Examination of Water from Elder's Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	27	27	23	29	26	31	29	25	31	27	26
Number of sample,	13712	13889	14037	14197	14376	14541	14729	14912	15238	15440	15611	15797
PLANTS.												
Diatomaceæ,	33	1	11	17	5	21	44	274	13	20	29	40
Asterionella,	33	1	3	11	0	0	15	252	12	15	0	16
Cyclotella,	pr.	0	0	0	0	3	9	0	0	3	24	17
Diatoma,	0	0	0	0	2	2	0	2	0	0	0	0
Navicula,	0	0	0	0	0	0	4	0	1	1	2	2
Synedra,	pr.	0	3	5	3	3	7	20	0	1	3	5
Tabellaria,	0	0	5	1	0	13	9	0	0	0	0	0
Cyanophyceæ,	pr.	0	0	0	20	136	75	110	115	48	6	28
Anabæna,	0	0	0	0	20	0	2	0	60	0	0	0
Merismopedia,	0	0	0	0	0	0	5	8	0	0	0	0
Microcystis,	pr.	0	0	0	0	136	68	84	52	48	6	28
Oscillaria,	0	0	0	0	0	0	0	18	3	0	0	0
Algæ,	10	0	2	0	20	7	31	29	10	0	1	12
Glœocapsa,	0	0	0	0	20	0	0	7	0	0	1	0
Protococcus,	6	0	0	0	0	7	23	18	8	0	0	0
Raphidium,	4	0	2	0	0	0	8	4	2	0	0	12
ANIMALS.												
Infusoria,	1	26	33	6	4	1	9	49	4	0	9	3
Dinobryon,	0	19	0	0	0	0	0	0	0	0	8	0
Dinobryon cases,	pr.	5	32	0	0	0	0	0	0	0	0	3
Encysted infusorian,	0	0	0	5	0	0	0	0	0	0	0	0
Peridinium,	1	2	1	1	0	0	7	48	3	0	1	0
Phacus,	0	0	0	0	0	0	0	1	1	0	0	0
Trachelomonas,	0	0	0	0	0	1	2	0	0	0	0	0
Vorticella,	0	0	0	0	4	0	0	0	0	0	0	0
Vermes, Anurea,	0	0	0	0	0	0	0	0	1	0	0	1
Miscellaneous, Zoöglœa,	42	9	36	0	40	0	0	0	0	0	0	0
TOTAL,	86	36	82	23	89	165	159	462	143	68	45	84

TAUNTON.

Chemical Examination of Water from the Filter-basin of the Taunton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13714	Jan. 24	V slight.	Slight.	.05	4.15	1.00	.0000	.0114	.0070	.0044	.56	.0400	.0000	.0948	1.4
13887	Feb. 25	Slight.	Cons.	.02	4.40	1.20	.0000	.0132	.0080	.0052	.40	.0350	.0001	.0727	1.6
14040	Mar. 25	Slight.	Slight.	.05	3.95	1.35	.0002	.0114	.0058	.0056	.56	.0380	.0002	.0847	1.4
14199	Apr. 22	Slight.	Cons.	.10	3.85	1.25	.0000	.0124	.0074	.0050	.56	.0150	.0001	.2354	1.4
14378	May 27	Distinct.	Cons.	.10	4.75	1.55	.0000	.0208	.0108	.0100	.61	.0220	.0005	.2090	1.6
14544	June 25	Distinct.	Cons.	.05	4.75	1.60	.0006	.0120	.0076	.0044	.60	.0300	.0007	.0847	1.3
14732	July 29	V. slight.	Slight.	.18	3.65	1.50	.0018	.0112	.0102	.0010	.63	.0350	.0005	.2079	1.7
14914	Aug. 26	Distinct.	Slight.	.02	3.75	1.30	.0032	.0116	.0082	.0034	.60	.0200	.0005	.0702	1.1
15237	Sept. 23	Slight.	V. slight.	.08	4.10	1.35	.0050	.0204	.0114	.0090	.56	.0180	.0005	.1685	1.4
15438	Oct. 28	Distinct.	Slight.	.12	4.05	1.20	.0004	.0212	.0122	.0090	.57	.0150	.0002	.1888	1.1
15613	Nov. 25	Slight.	Slight, green.	.07	3.85	1.05	.0004	.0122	.0076	.0046	.58	.0150	.0001	.1482	1.4
15796	Dec. 23	Slight.	Slight, gray.	.03	3.85	1.10	.0014	.0110	.0066	.0044	.59	.0220	.0001	.2502	1.1
Av.	....	....	....	.07	4.08	1.28	.0011	.0141	.0086	.0055	.57	.0254	.0003	.1513	1.4

Averages by Years.

-	1887*	-	-	.29	5.66	-	.0017	.0092	-	-	.60	.0167	-	-	-
-	1888	-	-	.47	5.40	-	.0010	.0120	-	-	.53	.0150	.0001	-	-
-	1889	-	-	.29	5.12	-	.0012	.0073	-	-	.57	.0185	.0001	-	-
-	1890	-	-	.33	5.91	-	.0012	.0087	-	-	.57	.0227	.0001	-	1.9
-	1891	-	-	.35	5.25	3.76	.0014	.0073	-	-	.55	.0212	.0000	-	1.7
-	1892	-	-	.60	5.53	3.88	.0005	.0124	-	-	.58	.0147	.0001	-	1.6
-	1893	-	-	.82	5.41	1.82	.0026	.0149	-	-	.57	.0114	.0001	.6763	1.4
-	1894	-	-	.26	4.36	1.16	.0008	.0132	.0095	.0037	.55	.0175	.0001	.2871	1.2
-	1895	-	-	.07	4.08	1.28	.0011	.0141	.0086	.0055	.57	.0254	.0003	.1513	1.4

* June to December.

NOTE to analyses of 1895: Odor, generally vegetable; in August and September, decidedly disagreeable.——The samples were collected from the filter-basin.

TAUNTON.

Microscopical Examination of Water from the Filter-basin of the Taunton Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	28	28	23	29	26	31	29	25	30	27	26
Number of sample,	13714	13887	14040	14199	14378	14544	14732	14914	15237	15438	15613	15796
PLANTS.												
Diatomaceæ,	206	652	741	1,948	6,672	580	21	318	7	76	51	138
Asterionella,	204	628	580	660	72	0	1	0	2	30	31	110
Cyclotella,	0	0	0	0	0	216	3	0	5	0	0	0
Diatoma,	1	1	0	0	0	0	0	0	0	8	13	0
Fragilaria,	0	0	20	0	0	0	12	62	0	0	0	0
Navicula,	1	1	1	0	0	0	1	0	0	2	0	pr.
Synedra,	0	22	140	1,288	6,600	364	4	256	0	36	7	28
Cyanophyceæ, Oscillaria,	0	pr.	1	1	0	0	0	11	0	0	0	0
Algæ,	0	152	125	0	28	0	29	7	32	68	80	27
Chlorococcus,	0	152	0	0	0	0	0	0	0	0	4	0
Cœlastrum,	0	0	0	0	0	0	0	0	24	0	0	0
Eudorina,	0	0	0	0	0	0	0	0	2	24	76	1
Pandorina,	0	0	0	0	0	0	0	0	0	0	0	26
Protococcus,	0	0	124	0	0	0	29	4	0	28	0	0
Raphidium,	0	0	0	0	0	0	0	1	0	16	0	0
Scenedesmus,	0	pr.	1	0	28	0	pr.	2	6	0	0	pr.
Fungi, Crenothrix,	0	pr.	0	0	18	0	0	2	0	0	0	0
ANIMALS.												
Infusoria,	3	11	241	213	28	1	18	868	154	8	7	3
Dinobryon,	0	8	140	69	0	0	0	0	0	0	0	0
Dinobryon cases,	0	3	100	136	0	1	2	636	0	0	0	0
Euglena,	0	0	0	0	0	0	0	0	0	2	0	0
Monas,	0	0	1	0	0	0	0	0	0	0	2	2
Peridinium,	3	0	0	8	0	0	16	232	152	4	5	1
Trachelomonas,	0	0	0	0	28	0	0	0	2	2	0	0
Vermes,	0	0	0	0	3	0	1	1	0	10	2	0
Anurea,	0	0	0	0	3	0	1	1	0	6	2	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0	4	0	0
Miscellaneous, Zoöglœa,	0	0	0	0	0	0	0	18	40	0	0	0
TOTAL,	209	815	1,108	2,162	6,749	581	69	1,225	233	162	140	168

TAUNTON.

Chemical Examination of Water from the Taunton River, at Taunton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13713	Jan. 24	Slight.	Slight.	1.30	4.80	2.35	.0026	.0196	.0186	.0010	.58	.0080	.0000	1.0033	1.3
13886	Feb. 25	Slight.	Slight.	1.05	5.20	2.00	.0046	.0192	.0182	.0010	.66	.0120	.0001	0.8255	1.1
14039	Mar. 25	Slight.	Cons.	0.95	3.70	1.35	.0008	.0206	.0194	.0012	.50	.0030	.0001	0.9124	0.9
14198	Apr. 22	Slight.	Cons.	1.50	4.45	2.50	.0010	.0260	.0250	.0010	.55	.0030	.0001	1.4615	0.9
14377	May 27	V. slight.	Cons.	1.50	6.35	3.65	.0022	.0384	.0326	.0058	.54	.0100	.0001	1.6340	1.1
14543	June 25	V. slight.	Slight.	1.30	5.45	2.60	.0016	.0258	.0240	.0018	.60	.0050	.0001	0.8778	0.9
14731	July 29	V. slight.	Cons.	1.20	5.30	1.80	.0024	.0310	.0274	.0036	.66	.0100	.0000	0.9386	1.4
14913	Aug. 26	V. slight.	Slight.	0.85	5.10	1.80	.0020	.0234	.0218	.0016	.68	.0030	.0001	0.6396	0.9
15236	Sept. 23	V. slight.	Slight.	0.62	4.90	1.95	.0006	.0206	.0194	.0012	.72	.0120	.0000	0.5070	0.9
15437	Oct. 28	V. slight.	Slight.	1.30	6.55	3.05	.0022	.0352	.0322	.0030	.76	.0150	.0001	1.3946	1.6
15612	Nov. 25	V. slight.	Slight.	1.60	6.30	3.45	.0010	.0312	.0298	.0014	.58	.0050	.0001	1.6302	1.3
15795	Dec. 23	Slight.	Slight, brown.	1.10	4.80	1.90	.0020	.0212	.0194	.0018	.65	.0070	.0002	1.2705	0.8
Av.	....	....	....	1.19	5.24	2.37	.0019	.0260	.0240	.0020	.62	.0077	.0001	1.0912	1.1

Averages by Years.

-	1887*	-	-	1.29	5.84	2.09	.0030	.0285	-	-	.59	.0097	-	-	-
-	1888	-	-	1.51	5.25	2.28	.0015	.0294	-	-	.44	.0086	.0001	-	-
-	1889	-	-	1.67	4.50	2.17	.0015	.0304	.0270	.0034	.45	.0085	.0001	-	-
-	1890	-	-	1.31	5.36	2.27	.0016	.0254	.0225	.0029	.48	.0118	.0001	-	1.3
-	1891	-	-	1.12	4.77	1.98	.0006	.0220	.0197	.0023	.47	.0095	.0001	-	1.0
-	1892	-	-	1.08	5.27	2.20	.0012	.0225	.0198	.0027	.54	.0093	.0001	-	1.1
-	1893	-	-	1.38	5.33	2.31	.0043	.0246	.0212	.0034	.56	.0078	.0002	1.0820	1.1
-	1894	-	-	1.28	5.01	2.15	.0027	.0224	.0190	.0034	.60	.0047	.0001	0.9372	1.1
-	1895	-	-	1.19	5.24	2.37	.0019	.0260	.0240	.0020	.62	.0077	.0001	1.0912	1.1

* June to December.

NOTE to analyses of 1895: Odor, vegetable, sometimes also mouldy. —— The samples were collected from the river, opposite the filter-basin of the Taunton Water Works.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 79.

UXBRIDGE.

Water Supply of Uxbridge.

Chemical Examination of Water from a Well in the Yard of Capron's Mill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
15374	1895. Oct. 15	V. slight.	Slight, fibrous.	.04	6.20	.0138	.0014	.32	.1900	.0004	.0507	2.3	.0340

Odor, none; on heating, faintly unpleasant. —— Water from this source was used as a supplementary supply for the town during the summer of 1895.

Microscopical Examination.

Miscellaneous, *Zoöglœa*, 30.

Water Supply of Wakefield and Stoneham. — Wakefield Water Company.

Chemical Examination of Water from Crystal Lake, Wakefield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13974	Mar. 13	V. slight.	Slight.	.12	4.50	1.15	.0038	.0146	.0130	.0016	.79	.0200	.0000	.2624	1.9
14472	June 10	V. slight.	Slight.	.20	4.45	1.90	.0038	.0168	.0134	.0034	.69	.0050	.0000	.3214	1.6
15138	Sept. 9	Distinct.	Slight.	.15	4.25	1.40	.0000	.0194	.0150	.0044	.68	.0000	.0000	.3861	1.6
15721	Dec. 10	Distinct.	Cons.	.25	4.65	1.55	.0016	.0158	.0146	.0012	.69	.0100	.0000	.3260	1.8
Av.	....	....	....	.18	4.46	1.50	.0023	.0166	.0140	.0026	.71	.0087	.0000	.3240	1.7

Averages by Years.

-	1887*	-	-	.17	3.73	0.91	.0006	.0174	-	-	.51	.0043	-	-	-
-	1888†	-	-	.13	3.69	0.92	.0009	.0167	-	-	.48	.0080	.0001	-	-
-	1889‡	-	-	.10	3.60	0.87	.0009	.0141	.0119	.0022	.49	.0163	.0002	-	-
-	1890§	-	-	.25	4.22	1.35	.0001	.0371	.0190	.0181	.46	.0090	.0001	-	1.8
-	1891‖	-	-	.08	4.17	1.50	.0003	.0160	.0129	.0031	.47	.0145	.0001	-	1.6
-	1893	-	-	.14	3.81	1.27	.0028	.0164	.0141	.0023	.57	.0108	.0001	.2638	1.5
-	1894	-	-	.16	4.39	1.26	.0011	.0155	.0136	.0019	.67	.0105	.0001	.2371	1.8
-	1895	-	-	.18	4.46	1.50	.0023	.0166	.0140	.0026	.71	.0087	.0000	.3240	1.7

* June to December. † January to October. ‡ January, March and June.
§ Three in October. ‖ May and November.

Note to analyses of 1895: Odor of the first sample, faintly vegetable; of the second, distinctly vegetable and grassy; of the third, none; of the fourth, decided. —— The samples were collected from a faucet at the pumping station.

WAKEFIELD AND STONEHAM.

Microscopical Examination of Water from Crystal Lake, Wakefield.

[Number of organisms per cubic centimeter.]

	1895.			
	March.	June.	September.	December.
Day of examination,	14	14	13	12
Number of sample,	13974	14472	15138	15721
PLANTS.				
Diatomaceæ,	**2**	**35**	**52**	**182**
Asterionella,	1	0	36	132
Cyclotella,	0	29	0	3
Fragilaria,	0	4	0	0
Melosira,	0	0	9	28
Synedra,	0	0	2	1
Tabellaria,	1	2	5	18
Cyanophyceæ,	**0**	**75**	**0**	**1**
Anabæna spores,	0	23	0	0
Microcystis,	0	52	0	1
Algæ,	**0**	**6**	**4**	**0**
Protococcus,	0	6	0	0
Raphidium,	0	0	4	0
Fungi, Molds,	**0**	**6**	**0**	**0**
ANIMALS.				
Infusoria,	**0**	**0**	**1**	**2**
Cryptomonas,	0	0	0	1
Peridinium,	0	0	0	1
Trachelomonas,	0	0	1	0
Vermes,	**0**	**1**	**1**	**0**
Anurea,	0	0	1	0
Rotifer,	0	1	0	0
Miscellaneous,	**0**	**39**	**0**	**.04**
Acarina,	0	0	0	.04
Zoöglœa,	0	39	0	0
TOTAL,	2	162	58	185

WALPOLE.

The advice of the State Board of Health to the town of Walpole relative to the introduction of a public water supply from the ground in the valley of Low Brook, a short distance above its junction with the Neponset River, may be found on pages 50 and 51 of this volume. The analysis of a sample of water taken from test wells in the vicinity of the brook, below Washington Street, is here given.

Works for supplying the town of Walpole with water taken from the ground in this vicinity were nearly completed at the end of 1895.

WALPOLE.

Chemical Examination of Water from a Group of Tubular Test Wells in the Valley of Low Brook, Walpole.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14183	Apr. 17	None.	None.	.00	5.60	.0000	.0014	.29	.0030	.0000	.0118	1.3	.0010

Odor, none. —— The sample was collected from a pump drawing water from seven tubular test wells in the valley of Low Brook, just below Washington Street.

Microscopical Examination.

No organisms.

Water Supply of Waltham.

Chemical Examination of Water from the Well and Filter-basin of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13662	Jan. 15	None.	None.	.00	7.20	.0034	.0028	.59	.0170	.0000	.0553	3.2	.0040
13794	Feb. 11	None.	Slight.	.01	9.80	.0042	.0024	.53	.0150	.0000	.0608	3.6	.0070
13836	Feb. 18	None.	None.	.00	7.30	.0038	.0032	.52	.0150	.0000	.0468	3.4	.0060
14164	April 17	None.	None.	.02	6.70	.0024	.0016	.52	.0220	.0000	.0750	3.2	.0100
14312	May 16	None.	None.	.04	6.45	.0032	.0016	.52	.0220	.0000	.0513	3.0	.0070
14479	June 18	None.	None.	.02	7.05	.0100	.0024	.51	.0150	.0000	.0351	3.4	.0100
14666	July 22	None.	None.	.04	6.60	.0018	.0026	.55	.0300	.0000	.0600	3.5	.0090
14857	Aug. 19	None.	None.	.01	7.10	.0034	.0034	.54	.0180	.0000	.0546	3.4	.0100
15194	Sept. 17	None.	None.	.05	7.40	.0020	.0014	.51	.0220	.0000	.0507	3.4	.0060
15356	Oct. 14	None.	V. slight.	.05	7.60	.0034	.0020	.55	.0170	.0000	.0725	3.9	.0145
15557	Nov. 18	None.	None.	.02	7.10	.0032	.0022	.56	.0150	.0000	.0507	3.4	.0075
15730	Dec. 16	None.	None.	.07	6.95	.0030	.0034	.51	.0250	.0000	.0462	3.5	.0055
Av.*	....	....	....	.03	7.15	.0036	.0024	.53	.0198	.0000	.0550	3.4	.0082

Averages by Years.

–	1887†	–	–	.00	6.71	.0007	.0038	.47	.0250	–	–	–	–
–	1888	–	–	.00	6.70	.0009	.0054	.46	.0273	.0003	–	–	–
–	1889‡	–	–	.00	6.43	.0006	.0034	.48	.0378	.0002	–	–	–
–	1890§	–	–	.00	–	.0000	.0012	.47	.0380	.0002	–	–	–
–	1892	–	–	.00	6.81	.0033	.0027	.45	.0162	.0000	–	3.4	–
–	1893	–	–	.01	6.86	.0036	.0022	.47	.0179	.0000	.0643	3.4	.0020
–	1894	–	–	.02	6.75	.0028	.0019	.51	.0192	.0000	.0608	3.1	.0044
–	1895	–	–	.03	7.15	.0036	.0024	.53	.0198	.0000	.0550	3.4	.0082

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† June to December. ‡ January to May. § July.

Note to analyses of 1895: Odor, none. —— The samples collected in January, February and October were taken from the filter-basin, and the other samples from a faucet at the pumping station.

Microscopical Examination.

Crenothrix was present in seven of these samples, the highest number found in any sample being 88, in December. No. 4164 was not examined. No organisms were found in the other samples.

WALTHAM.

Chemical Examination of Water from the Distributing Reservoir of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13663	Jan. 15	V. slight, green.	V. slight.	.03	6.80	.0002	.0064	.54	.0180	.0000	.0750	3.2	.0000
13837	Feb. 18	V. slight.	Cons.	.00	6.60	.0008	.0134	.53	.0100	.0000	.1209	3.4	.0030
14165	Apr. 17	None.	Slight.	.02	6.70	.0020	.0026	.42	.0230	.0000	.0671	3.4	.0060
14313	May 16	Distinct.	Slight.	.03	6.75	.0008	.0226	.56	.0050	.0000	.0987	3.0	.0035
14480	June 18	Distinct.	Slight.	.02	6.75	.0008	.0154	.53	.0070	.0001	.1092	3.2	.0010
14665	July 22	None.	V. slight.	.04	7.05	.0024	.0050	.54	.0350	.0000	.0600	3.4	.0125
14856	Aug. 19	V. slight.	Slight.	.02	7.80	.0038	.0030	.54	.0100	.0001	.0702	3.5	.0050
15195	Sept. 17	Decided, brown.	Slight, brown.	.12	7.55	.0010	.0078	.53	.0130	.0003	.1108	3.4	.0060
15357	Oct. 14	V. slight.	Slight.	.05	6.85	.0000	.0078	.53	.0180	.0000	.1014	3.2	.0070
15558	Nov. 18	V. slight.	V. slight.	.02	7.15	.0034	.0028	.56	.0180	.0000	.0780	3.4	.0035
15731	Dec. 16	Distinct.	Slight.	.05	6.95	.0026	.0064	.52	.0200	.0000	.0554	3.5	.0025
Av.	....	....	....	.04	7.00	.0016	.0085	.53	.0161	.0000	.0861	3.3	.0045

Averages by Years.

-	1887*	-	-	.00	6.66	.0007	.0061	.46	.0197	-	-	-	-
-	1888	-	-	.00	6.45	.0003	.0075	.46	.0248	.0003	-	-	-
-	1889†	-	-	.00	6.21	.0003	.0078	.47	.0280	.0003	-	-	-
-	1890‡	-	-	.00	-	.0000	.0124	.47	.0280	.0001	-	-	-
-	1891§	-	-	.00	6.25	.0000	.0044	.40	.0200	.0000	-	3.0	-
-	1892	-	-	.01	6.28	.0006	.0082	.44	.0119	.0001	-	3.0	-
-	1893	-	-	.04	6.72	.0006	.0074	.47	.0127	.0001	.1033	3.1	.0019
-	1894	-	-	.03	6.80	.0007	.0140	.51	.0078	.0001	.0926	3.1	.0032
-	1895	-	-	.04	7.00	.0016	.0085	.53	.0161	.0000	.0861	3.3	.0045

* June to December. † January to May. ‡ February. § May.

NOTE to analyses of 1895: Odor, none, except in June and July, when it was unpleasant; on heating, a faintly grassy or unpleasant odor was developed in some of the samples. —— The samples were collected from the reservoir.

WALTHAM.

Microscopical Examination of Water from the Distributing Reservoir of the Waltham Water Works.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	16	20	-	17	19	24	20	19	15	20	18
Number of sample,	13663	13837	14165	14313	14480	14665	14856	15195	15357	15558	15731
PLANTS.											
Diatomaceæ,	**1,463**	**10,800**	-	**588**	**162**	**0**	**142**	**0**	**1**	**371**	**5,812**
Asterionella,	43	240	-	380	0	0	0	0	0	368	5,800
Cyclotella,	0	0	-	0	87	0	2	0	0	0	0
Synedra,	1,420	10,560	-	208	75	0	140	0	1	3	12
Cyanophyceæ, Oscillaria,	**0**	**0**	-	**0**	**0**	**18**	**0**	**0**	**0**	**0**	**0**
Fungi,	**17**	**5**	-	**1,620**	**3,000**	**46**	**3**	**0**	**0**	**0**	**3**
Crenothrix,	5	5	-	0	0	0	3	0	0	0	3
Leptothrix,	12	0	-	1,620	3,000	46	0	0	0	0	0
ANIMALS.											
Infusoria,	**7**	**3**	-	**0**	**22**	**19**	**1**	**0**	**0**	**0**	**0**
Dinobryon,	0	0	-	0	22	19	0	0	0	0	0
Monas,	0	2	-	0	0	0	0	0	0	0	0
Peridinium,	7	1	-	0	0	0	1	0	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	-	**0**	**0**	**0**	**0**	**0**	**20**	**0**	**0**
TOTAL,	1,487	10,808	-	2,208	3,184	83	146	0	21	371	5,815

WATER SUPPLY OF WARE.

Chemical Examination of Water from a Faucet at the Pumping Station of the Ware Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
15228	1895. Sept. 21	None.	None.	.00	5.10	.0000	.0000	.28	.0570	.0000	.0234	1.9	.0020

WARE.

Chemical Examination of Water from a Faucet at the Pumping Station of the Ware Water Works — Concluded.

Averages by Years.

[Parts per 100,000.]

Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
1887*	-	-	.00	7.05	.0001	.0011	0.50	.2663	-	-	-	-
1888	-	-	.00	7.58	.0000	.0011	1.36	.3262	.0002	-	-	-
1889†	-	-	.00	8.14	.0001	.0013	0.89	.3111	.0000	-	-	-
1890‡	-	-	.00	-	.0002	.0014	0.95	.3400	.0000	-	-	-
1891§	-	-	.00	11.70	.0000	.0000	1.44	.7000	.0000	-	3.9	-
1892‖	-	-	.00	10.53	.0000	.0008	1.15	.5666	.0000	-	3.8	-
1893¶	-	-	.00	11.08	.0002	.0015	1.04	.4750	.0000	.0447	3.7	.0035
1894	-	-	.00	5.25	.0014	.0006	0.27	.1000	.0000	.0065	2.0	.0010
1895**	-	-	.00	5.10	.0000	.0000	0.28	.0570	.0000	.0234	1.9	.0020

* June to November. † January to June. ‡ February.
§ November. ‖ February, July and December. ¶ February and August.
** September.

NOTE to analyses of 1895: Odor, none. — The sample was collected from a faucet at the pumping station, while pumping from the large well and tubular wells.

Microscopical Examination.

No organisms.

WASHINGTON.

Chemical Examination of Water from West Pond and Roaring Brook, Washington.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
14822	Aug. 11	Distinct.	Slight.	1.80	6.20	4.15	.0032	.0446	.0394	.0052	.07	.0020	.0002	2.3400	1.6
15722	Dec. 10	V. slight.	Slight.	1.30	5.40	3.15	.0006	.0352	.0334	.0018	.04	.0050	.0000	1.6185	1.4
15837	Jan. 3	None.	Slight.	1.20	4.30	2.60	.0002	.0228	.0212	.0016	.04	.0130	.0000	1.5400	1.3
15838	Jan. 3	None.	Slight.	1.30	4.60	2.90	.0000	.0262	.0240	.0022	.05	.0130	.0000	1.7440	1.1

Odor of the first two and last samples, vegetable; of the third sample, none. — The first sample was collected from West Pond, near its centre; the second and last samples, from Roaring Brook, near the outlet of West Pond; the third sample, from Roaring Brook, at the first road crossing below West Pond. The samples were collected during an investigation relative to an additional water supply for Pittsfield.

Microscopical Examination.

No. 14822. Diatomaceæ, *Cocconeis*, 12; *Cyclotella*, 760; *Synedra*, 60; *Tabellaria*, 12. Cyanophyceæ, *Merismopedia*, 8; *Microcystis*, 2; *Oscillaria*, 2. Algæ, *Conferva*, 8; *Glœocapsa*, 1; *Pediastrum*, 2; *Protococcus*, 26; *Raphidium*, 4; *Scenedesmus*, 7. Fungi, *Crenothrix*, 6. Infusoria, *Dinobryon cases*, 68; *Peridinium*, 2; *Phacus*, 1; *Trachelomonas*, 3. Vermes, *Anurea*, 3; *Rotatorian ova*, 1. Miscellaneous, *Zoöglœa*, 30. Total, 1,018.

No. 15722. Diatomaceæ, *Cymbella*, 1; *Meridion*, 1; *Synedra*, 1. Miscellaneous, *Zoöglœa*, 3. Total, 6.

Nos. 15837 and 15838 were not examined microscopically.

WATERTOWN AND BELMONT.

Water Supply of Watertown and Belmont. — Watertown Water Supply Company.

Chemical Examination of Water from a Faucet in the Pumping Station of the Watertown Water Supply Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13664	Jan. 14	Slight, milky.	Slight.	.05	9.60	.0046	.0074	.74	.1400	.0000	.1066	4.0	.0240
13995	Mar. 18	V. slight.	Slight, floc.	.10	6.20	.0018	.0060	.55	.0680	.0000	.1540	3.4	.0180
14159	Apr. 15	None.	V. slight.	.10	7.60	.0014	.0064	.64	.0950	.0000	.1501	3.1	.0200
14311	May 15	Slight.	V. slight.	.18	7.80	.0064	.0052	.62	.0500	.0000	.1145	3.4	.0570
14493	June 18	Distinct, milky.	None.	.25	8.70	.0098	.0072	.60	.0300	.0000	.1365	3.4	.0580
14715	July 25	Slight, milky.	Slight, rusty.	.28	8.20	.0094	.0086	.75	.0350	.0000	.2002	4.0	.0650
14873	Aug. 19	Slight, milky.	Slight, rusty.	.18	9.70	.0090	.0044	.70	.0470	.0000	.1248	3.8	.0620
15182	Sept. 17	Distinct, milky.	Slight, rusty.	.38	11.40	.0012	.0088	.79	.0280	.0000	.2106	5.6	.0920
15375	Oct. 14	Distinct.	Cons., floc.	.30	10.90	.0046	.0128	.71	.1200	.0007	.2168	4.3	.1000
15574	Nov. 18	Distinct, milky.	V. slight.	.22	7.40	.0028	.0092	.74	.0380	.0004	.2145	2.9	.0300
15756	Dec. 16	Distinct.	V. slight.	.15	8.80	.0046	.0090	.73	.0850	.0018	.1247	3.2	.0540
Av.	....	....	....	.20	8.75	.0051	.0077	.69	.0669	.0003	.1594	3.7	.0527

Averages by Years.

-	1887*	-	-	.00	7.09	.0005	.0034	.65	.0300	-	-	-	-
-	1888	-	-	.00	7.22	.0000	.0040	.63	.0647	.0000	-	-	-
-	1889†	-	-	.00	6.45	.0000	.0027	.64	.0642	.0000	-	-	-
-	1890‡	-	-	.00	7.40	.0014	.0042	.69	.0450	.0000	-	3.9	-
-	1892§	-	-	.07	7.90	.0041	.0046	.66	.0370	.0001	-	4.0	.0396
-	1893	-	-	.19	7.95	.0063	.0061	.66	.0489	.0001	.1275	3.5	.0315
-	1894	-	-	.11	8.82	.0048	.0054	.70	.0542	.0001	.1224	3.8	.0516
-	1895	-	-	.20	8.75	.0051	.0077	.69	.0669	.0003	.1594	3.7	.0527

* June to December. † January to May. ‡ August. § September to December.

NOTE to analyses of 1895: Odor, generally none; in July, distinctly vegetable; in September, November and December, faintly vegetable.——The samples were collected from a faucet at the pumping station.

WATERTOWN AND BELMONT.

Microscopical Examination of Water from a Faucet in the Pumping Station of the Watertown Water Supply Company.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	16	20	17	17	20	27	21	18	17	20	20
Number of sample,	13664	13995	14159	14311	14493	14715	14873	15182	15375	15574	15756
PLANTS.											
Algæ, Protococcus,	0	0	6	0	0	0	0	0	0	0	0
Fungi,	176	24	11	680	54	72	54	18	33	160	10
Crenothrix,	176	24	11	680	54	44	54	18	28	160	10
Molds,	0	0	0	0	0	28	0	0	5	0	0
Miscellaneous, Zoöglœa,	0	0	0	16	0	0	18	0	100	1	0
TOTAL,	176	24	17	696	54	72	72	18	133	161	10

Chemical Examination of Water from a Faucet in Watertown, supplied from the Works of the Watertown Water Supply Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13610	Jan. 7	V. slight, milky.	None.	.08	9.80	.0002	.0042	.74	.0800	.0000	.0624	4.6	.0220
13779	Feb. 6	None.	None.	.02	8.70	.0002	.0048	.70	.1500	.0000	.0987	4.0	.0140
13946	Mar. 6	None.	None.	.05	9.50	.0000	.0036	.70	.0980	.0000	.0708	4.6	.0240
14090	Apr. 3	None.	None.	.08	8.60	.0006	.0038	.59	.1030	.0000	.0770	3.6	.0170
14256	May 7	None.	None.	.08	9.00	.0000	.0048	.66	.0630	.0000	.0639	3.8	.0130
14432	June 5	Slight, milky.	None.	.05	8.70	.0002	.0046	.62	.0480	.0000	.0707	4.0	.0180
14604	July 10	None.	V. slight.	.08	9.70	.0004	.0048	.70	.0330	.0000	.1027	4.4	.0120
14783	Aug. 7	V. slight, milky.	V. slight.	.10	9.50	.0028	.0040	.71	.0500	.0006	.1014	6.4	.0250
14990	Sept. 4	Slight, milky.	None.	.20	11.20	.0124	.0062	.79	.0200	.0003	.1655	5.6	.0500
15320	Oct. 7	Distinct, milky.	None.	.25	10.60	.0048	.0054	.80	.0250	.0002	.1521	5.3	.0430
15498	Nov. 6	Slight, milky.	None.	.15	9.90	.0000	.0066	.69	.0580	.0000	.1264	4.3	.0180
15677	Dec. 4	Slight, milky.	None.	.12	7.90	.0000	.0058	.68	.0720	.0000	.1209	3.8	.0120
15761	Dec. 17	Decided, milky.	Slight, rusty.	.63	10.30	.0000	.0106	.64	.1000	.0001	.1732	4.4	.2250
Av.*	....	....	....	.13	9.52	.0018	.0051	.75	.0678	.0001	.1032	4.6	.0312

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

WATERTOWN AND BELMONT.

Chemical Examination of Water from a Faucet in Watertown, supplied from the Works of the Watertown Water Supply Company — Concluded.

Averages by Years.

[Parts per 100,000.]

Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
1893	-	-	.09	8.06	.0012	.0052	.61	.0426	.0001	.1322	3.7	.0165
1894	-	-	.11	9.32	.0001	.0042	.71	.0490	.0000	.0976	4.6	.0177
1895	-	-	.13	9.52	.0018	.0051	.75	.0678	.0001	.1032	4.6	.0312

NOTE to analyses of 1895: Odor, generally none; on September 4 and December 17, faintly vegetable; in October, faintly oily.—— The samples were collected from a faucet in a house in the easterly part of Watertown.

Microscopical Examination.

Crenothrix was found in eight of these samples, the highest number being 640 in the last sample, and the next highest 76, in No. 14990.

Chemical Examination of Water from Faucets in Watertown, supplied from the Works of the Watertown Water Supply Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13838	Feb. 18	None.	None.	.10	8.90	.0008	.0042	.76	.1100	.0000	.0624	4.0	.0230
15137	Sept. 9	Slight, milky.	Slight.	.25	11.90	.0102	.0064	.76	.0050	.0015	.2340	5.7	.0600
15168	Sept. 13	Distinct, milky.	Slight, rusty.	.40	10.00	.0156	.0084	.70	.0170	.0010	.2278	4.4	.0760

Odor of the first sample, none; of the others, faintly vegetable.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

Water Supply of Wayland.

Chemical Examination of Water from the Wayland Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13891	Feb. 26	Slight.	Slight.	0.37	4.55	.0018	.0092	.54	.0230	.0002	0.3097	1.9	.0475
14529	June 24	Slight.	Slight.	1.10	4.60	.0046	.0292	.31	.0050	.0001	0.8662	1.9	-
15472	Nov. 3	Slight.	Slight.	1.30	5.25	.0014	.0294	.40	.0200	.0002	1.4664	1.7	-
Av.	....	....	....	0.92	4.80	.0026	.0226	.42	.0160	.0002	0.8808	1.8	-

Odor, distinctly vegetable.——The first sample was collected from a faucet on the main pipe, and the others from a faucet in the gate-house.

Microscopical Examination of Water from the Wayland Water Works.

[Number of organisms per cubic centimeter.]

	1895. February.	1895. June.	1895. November.
Day of examination,	28	25	6
Number of sample,	13891	14529	15472
PLANTS.			
Diatomaceæ,	0	45	31
Asterionella,	0	0	8
Melosira,	0	34	14
Navicula,	0	1	3
Synedra,	0	8	6
Tabellaria,	0	2	0
Algæ,	0	2	2
Cosmarium,	0	0	2
Staurastrum,	0	2	0
Fungi, Crenothrix,	2,912	11	7
AMIMALS.			
Infusoria,	0	70	12
Dinobryon,	0	10	0
Dinobryon cases,	0	60	7
Mallomonas,	0	0	1
Peridinium,	0	0	2
Trachelomonas,	0	0	2
Miscellaneous, Zoöglœa,	0	0	60
Total,	2,912	128	112

WEBSTER.

Water Supply of Webster.

Chemical Examination of Water from the Well of the Webster Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13668	Jan. 15	Slight, rusty.	Slight, rusty.	.10	3.40	.0000	.0006	.21	.0280	.0000	.0079	1.3	.0400
13854	Feb. 19	Slight.	Slight.	.00	4.00	.0000	.0000	.20	.0180	.0000	.0000	1.1	.0000
13956	Mar. 11	None.	None.	.00	3.60	.0000	.0010	.21	.0100	.0000	.0139	1.3	.0000
14109	Apr. 8	None.	None.	.00	4.80	.0000	.0040	.21	.0280	.0000	.0000	1.3	.0020
14271	May 8	None.	Slight.	.00	3.50	.0000	.0014	.23	.0300	.0000	.0000	1.7	.0000
14447	June 11	None.	None.	.00	4.10	.0004	.0008	.23	.0220	.0000	.0195	1.7	.0020
14627	July 15	None.	None.	.00	5.00	.0000	.0012	.21	.0220	.0000	.0234	2.2	.0030
14817	Aug. 12	None.	None.	.00	6.25	.0000	.0010	.22	.0130	.0001	.0468	2.5	.0000
15105	Sept. 9	None.	None.	.00	4.60	.0000	.0014	.21	.0180	.0000	.0507	1.9	.0000
15334	Oct. 8	None.	V. slight.	.00	3.40	.0000	.0000	.24	.0150	.0000	.0351	1.4	.0000
15511	Nov. 11	None.	None.	.00	3.20	.0000	.0000	.25	.0300	.0000	.0140	1.1	.0000
15696	Dec. 9	None.	None.	.00	3.70	.0000	.0002	.26	.0480	.0000	.0039	1.1	.0050
Av.	1895	....	....	.00	4.13	.0000	.0010	.22	.0235	.0000	.0179	1.5	.0043
Av.	1894	....	....	.01	3.43	.0001	.0006	.21	.0232	.0000	.0103	1.4	.0032

Note to analyses of 1895: Odor, none except in May, when it was very faintly unpleasant, becoming vegetable on heating. —— The first two samples were collected from a faucet at the pumping station, and the others from the well.

Microscopical Examination.

No. 13668. Fungi, *Crenothrix*, 428.
No. 14271. Diatomaceæ, *Synedra*, 30. Miscellaneous, *Zoöglœa*, 22. Total, 52.
No. 13956 was not examined microscopically.
No organisms were found in the remaining samples.

Water Supply of Wellesley.

Chemical Examination of Water from the Filter-gallery of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14609	July 11	None.	Cons.	.02	6.50	.0010	.0038	.62	.0200	.0000	.0632	3.0	.0000
14765	Aug. 5	None.	Slight.	.08	6.25	.0006	.0066	.70	.0130	.0000	.1716	3.1	.0050

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1887*	-	-	.01	7.57	.0002	.0016	.54	.0979	-	-	-	-
-	1888	-	-	.00	6.57	.0001	.0023	.44	.0639	.0000	-	-	-
-	1889†	-	-	.00	5.89	.0005	.0021	.39	.0520	.0000	-	-	-
-	1890‡	-	-	.00	5.85	.0002	.0032	.73	.0400	.0000	-	4.0	-
-	1892§	-	-	.00	7.90	.0000	.0000	.53	.0550	.0000	-	3.8	.0000
-	1893‖	-	-	.00	6.70	.0000	.0008	.52	.0600	.0000	.0657	2.8	.0050
-	1894¶	-	-	.03	6.60	.0008	.0023	.56	.0465	.0000	.0369	2.9	.0030
-	1895**	-	-	.05	6.38	.0008	.0052	.66	.0165	.0000	.1174	3.1	.0025

* June to December. † January to May. ‡ September. § October. ‖ July. ¶ June and October. ** July and August.

NOTE to analyses of 1895: Odor, none. —— The samples were collected from the filter-gallery.

Microscopical Examination.

No. 14609. Fungi, *Crenothrix*, 2.
No. 14765. No organisms.

Chemical Examination of Water from the Well of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
14608	July 11	None.	None.	.03	5.80	.0002	.0060	.66	.0200	.0000	.1580	2.6	.0010
14764	Aug. 5	None.	Slight.	.02	7.90	.0002	.0056	.62	.0480	.0000	.0780	3.8	.0000

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1890*	-	-	.00	6.15	.0002	.0052	.73	.1000	.0001	-	4.3	-
-	1892†	-	-	.00	6.55	.0000	.0034	.65	.0950	.0001	-	2.4	.0000
-	1893‡	-	-	.00	5.90	.0000	.0014	.60	.0600	.0000	.0657	2.3	.0100
-	1894§	-	-	.03	6.10	.0000	.0032	.69	.0515	.0000	.0712	2.6	.0015
-	1895‖	-	-	.03	6.85	.0002	.0058	.64	.0340	.0000	.1180	3.2	.0005

* September. † October. ‡ July. § June and October ‖ July and August.

NOTE to analyses of 1895: Odor of the first sample, none; of the second, faintly unpleasant, disappearing on heating. —— The samples were collected from the well at Williams Spring.

Microscopical Examination.

No organisms.

WENHAM.

Wenham.

The advice of the State Board of Health to the town of Wenham relative to the use of water from Pleasant Pond in that town as a public water supply may be found on pages 51 and 52 of this volume. The results of the analysis of a sample of water from this pond are given below.

Chemical Examination of Water from Pleasant Pond, Wenham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13964	Mar 11	V. slight.	V. slight.	.50	5.20	1.80	.0100	.0190	.0160	.0030	.82	.0220	.0003	.5544	2.5

Odor, very faintly vegetable, becoming stronger on heating.——The sample was collected from the pond, near its outlet.

Microscopical Examination.

Infusoria, *Dinobryon*, 1; *Dinobryon cases*, 20; *Peridinium*, 1. Total, 22.

Water Supply of Westborough.

Chemical Examination of Water from the Upper Sandra Reservoir, Westborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13682	Jan. 16	Slight.	Slight.	.40	3.15	1.05	.0006	.0142	.0130	.0012	.29	.0070	.0000	.4550	0.8
13978	Mar. 13	V. slight.	Slight.	.25	2.55	1.10	.0040	.0128	.0112	.0016	.20	.0180	.0000	.4016	0.3
14295	May 14	Distinct.	Cons.	.23	2.75	1.60	.0004	.0228	.0154	.0074	.20	.0030	.0000	.4108	0.3
14688	July 23	Decided.	Slight.	.28	3.70	1.80	.0000	.0900	.0334	.0566	.28	.0000	.0000	.3825	0.6
15264	Sept. 24	Distinct, green.	Slight, green.	.15	3.60	2.20	.0338	.0530	.0448	.0082	.23	.0030	.0001	.4719	0.2
15621	Nov. 26	V. slight.	Slight.	.50	2.80	1.55	.0084	.0290	.0234	.0056	.21	.0030	.0000	.6669	0.5
Av.	1895	....	....	.30	3.09	1.55	.0079	.0369	.0235	.0134	.23	.0057	.0000	.4648	0.4
Av.	1894	....	....	.39	3.32	1.57	.0061	.0384	.0200	.0184	.21	.0023	.0000	.4714	0.4

Note to analyses of 1895: Odor, generally faintly vegetable, sometimes distinctly vegetable; in September, vegetable and disagreeable. On heating, an oily odor was developed in the first sample.——The samples were collected from the upper reservoir.

WESTBOROUGH.

Microscopical Examination of Water from the Upper Sandra Reservoir, Westborough.

[Number of organisms per cubic centimeter.]

	1895.					
	Jan.	Mar.	May.	July.	Sept.	Nov.
Day of examination,	17	16	15	24	28	27
Number of sample,	13682	13978	14295	14688	15264	15621
PLANTS.						
Diatomaceæ,	**1**	**0**	**243**	**50**	**1**	**200**
Melosira,	0	0	8	0	0	0
Navicula,	0	0	0	50	0	0
Synedra,	1	0	220	0	1	200
Tabellaria,	0	0	15	0	0	0
Cyanophyceæ,	**0**	**0**	**22**	**29,050**	**6**	**0**
Anabæna,	0	0	7	29,000	0	0
Clathrocystis,	0	0	14	50	4	0
Microcystis,	0	0	1	0	2	0
Algæ,	**4**	**1**	**112**	**5,250**	**23**	**124**
Arthrodesmus,	0	0	0	0	0	108
Chlorococcus,	0	0	0	0	0	3
Protococcus,	4	0	67	0	1	0
Raphidium,	0	0	10	0	5	5
Scenedesmus,	0	0	13	50	8	1
Selenastrum,	0	0	0	0	8	5
Staurastrum,	0	0	6	5,200	1	0
Tetraspora,	0	0	16	0	0	0
Zoöspores,	0	1	0	0	0	2
Fungi, Crenothrix,	**0**	**3**	**1**	**0**	**0**	**0**
ANIMALS.						
Infusoria,	**30**	**132**	**358**	**150**	**136**	**7**
Dinobryon,	6	48	0	0	0	0
Dinobryon cases,	18	84	352	0	0	7
Monas,	0	0	0	50	1	0
Paramæcium,	0	0	0	100	0	0
Peridinium,	6	0	2	0	132	0
Trachelomonas,	0	0	4	0	3	0
Vermes,	**1**	**1**	**10**	**0**	**6**	**1**
Anurea,	0	0	4	0	6	1
Polyarthra,	0	1	2	0	0	0
Rotatorian ova,	0	0	1	0	0	0
Rotifer,	1	0	3	0	0	0
Miscellaneous,	**5**	**0**	**84**	**0**	**.04**	**40**
Acarina,	0	0	0	0	.04	0
Zoöglœa,	5	0	84	0	0	40
TOTAL,	41	137	830	34,500	172	372

WESTBOROUGH.

Chemical Examination of Water from the Lower Sandra Reservoir, Westborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended		Nitrates.	Nitrites.		
	1895.														
13683	Jan. 16	Slight.	Slight.	.22	3.30	1.20	.0008	.0186	.0146	.0040	.28	.0030	.0000	.3855	0.9
13979	Mar. 13	V. slight.	Cons.	.18	2.55	0.80	.0028	.0114	.0096	.0018	.22	.0180	.0000	.2920	0.6
14296	May 14	Slight.	Slight.	.12	2.70	1.50	.0004	.0142	.0106	.0036	.20	.0030	.0000	.2528	0.9
14689	July 23	Slight.	Slight.	.07	2.75	1.30	.0006	.0170	.0118	.0052	.27	.0000	.0000	.1612	1.3
15265	Sept. 24	Slight.	Slight.	.13	3.60	1.20	.0020	.0154	.0120	.0034	.23	.0030	.0000	.1677	1.1
15622	Nov. 26	V. slight.	Slight.	.25	3.30	1.50	.0002	.0240	.0178	.0062	.25	.0000	.0000	.4680	0.6
Av.	1895	....	....	.16	3.03	1.25	.0011	.0167	.0127	.0040	.24	.0045	.0000	.2879	0.9
Av.	1894	....	....	.07	3.15	1.16	.0009	.0126	.0092	.0034	.22	.0018	.0000	.1898	0.9

NOTE to analyses of 1895: Odor, vegetable; sometimes mouldy or unpleasant. On heating, a decided oily odor was developed in January and March.—— The samples were collected from the lower reservoir.

Microscopical Examination of Water from the Lower Sandra Reservoir, Westborough.

[Number of organisms per cubic centimeter.]

	1895. Jan.	Mar.	May.	July.	Sept.	Nov.
Day of examination,	17	16	15	25	28	27
Number of sample,	13683	13979	14296	14689	15265	15622
PLANTS.						
Diatomaceæ,	2	0	24	29	5	202
Navicula,	0	0	1	4	0	0
Synedra,	2	0	13	23	5	192
Tabellaria,	0	0	10	2	0	10
Cyanophyceæ, Anabæna,	0	0	10	53	0	8
Algæ,	0	4	31	17	0	93
Arthrodesmus,	0	0	0	0	0	88
Protococcus,	0	0	20	16	0	0
Raphidium,	0	0	4	0	0	4
Staurastrum,	0	0	7	1	0	1
Zoöspores,	0	4	0	0	0	0
Fungi, Crenothrix,	1	1	0	2	0	0

WESTBOROUGH.

Microscopical Examination of Water from the Lower Sandra Reservoir, Westborough — Concluded.

[Number of organisms per cubic centimeter.]

	1895.					
	Jan.	Mar.	May.	July.	Sept	Nov.
ANIMALS.						
Rhizopoda, Arcella,	0	0	0	0	0	1
Infusoria,	75	71	21	401	1	17
Dinobryon,	16	42	2	0	0	0
Dinobryon cases,	40	0	15	328	0	3
Euglena,	1	3	0	0	0	1
Peridinium,	18	2	3	72	0	12
Synura,	0	0	1	0	0	0
Tintinnidium,	0	0	0	0	0	1
Trachelomonas,	0	24	0	1	1	0
Vermes,	0	1	15	7	1	1
Anurea,	0	0	11	7	0	1
Polyarthra,	0	1	4	0	0	0
Rotifer,	0	0	0	0	1	0
Miscellaneous, Zoöglœa,	0	0	0	0	0	7
TOTAL,	78	77	101	509	7	321

WATER SUPPLY OF WESTBOROUGH INSANE HOSPITAL, WESTBOROUGH.

Chemical Examination of Water from the Tubular Wells at the Westborough Insane Hospital.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
13900	Feb. 27	Distinct, milky.	V. slight.	.55	11.90	.1440	.0040	.40	.0050	.0000	.1540	6.4	.2200
14349	May 22	Slight, milky.	V. slight.	.50	12.60	.1160	.0000	.40	.0000	.0000	.1087	5.9	.1520
14924	Aug. 27	Distinct, milky.	V. slight.	.60	12.00	.0992	.0032	.40	.0000	.0002	.1092	5.3	.0700
Av.	....	....	....	.55	12.17	.1197	.0024	.40	.0017	.0001	.1240	5.9	.1473

Averages by Years.

-	1887*	-	-	.03	11.29	.0407	.0033	.42	.0030	-	-	-	-
-	1888	-	-	.06	11.27	.0502	.0051	.42	.0045	.0000	-	-	-
-	1889†	-	-	.16	11.41	.0530	.0049	.43	.0030	.0000	-	-	-
-	1891‡	-	-	.50	11.80	.0784	.0109	.43	.0040	.0000	-	6.0	-
-	1893§	-	-	.33	11.09	.0758	.0056	.40	.0078	.0001	.1200	5.8	.0964
-	1894	-	-	.39	11.75	.1188	.0082	.37	.0007	.0000	.1466	6.1	.1687
-	1895‖	-	-	.55	12.17	.1197	.0024	.40	.0017	.0001	.1240	5.9	.1473

* June to December. † January to May. ‡ July, two samples.
§ January, March, May and July. ‖ February, May and August.

NOTE to analyses of 1895: Odor, none when cold. On heating, a distinctly unpleasant odor was developed in the last sample. —— The samples were collected from a faucet at the pumping station.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples.

WESTBOROUGH.

A communication from the selectmen of Northborough to the State Board of Health relative to the pollution of Little Chauncy Pond by the sewage of the Westborough Insane Hospital, and the advice of the State Board of Health to the trustees of the Westborough Insane Hospital relative to the disposal of the sewage from this institution may be found on pages 70 and 71 of this volume.

Analyses of samples of water from Chauncy and Little Chauncy ponds are given below.

Chemical Examination of Water from Chauncy Pond, Westborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
15627	Nov. 26	None.	V. slight.	.47	4.65	2.65	.0028	.0262	.0254	.0008	.39	.0050	.0001	.7379	1.6

Odor, faintly vegetable; on heating, distinctly mouldy.——The sample was collected from a faucet on the pump drawing water from Chauncy Pond.

Microscopical Examination.

An insignificant number of organisms was found in this sample.

Chemical Examination of Water from Chauncy and Little Chauncy Ponds, Westborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
15503	Nov. 10	Decided, green.	Slight, yellow.	.32	4.90	2.15	.0042	.0564	.0330	.0234	.45	.0030	.0001	.6880	1.3
15502	Nov. 10	Decided, green.	Slight, yellow.	.47	5.80	2.40	.0022	.0666	.0444	.0222	.51	.0050	.0002	.8408	1.7

Odor of the first sample, faintly vegetable, becoming stronger on heating; of the second sample, distinctly disagreeable.——The first sample was collected from Chauncy Pond at its outlet, and the second from Little Chauncy Pond at its outlet. The samples were collected during an investigation relative to the alleged pollution of Little Chauncy Pond by sewage from the Westborough Insane Hospital.

Microscopical Examination.

No. 15503. Diatomaceæ, *Asterionella*, 4; *Cyclotella*, 30; *Fragilaria*, 292; *Melosira*, 8; *Synedra*, 66; *Tabellaria*, 16. Cyanophyceæ, *Anabæna*, 760; *Chroöcoccus*, 2; *Clathrocystis*, 40; *Cœlosphærium*, 2; *Microcystis*, 40. Algæ, *Chlorococcus*, 18; *Raphidium*, 20; *Scenedesmus*, 2; *Staurastrum*, 4; *Zoöspores*, 6. Fungi, *Beggiatoa*, 2. Infusoria, *Monas*, 2. Vermes, *Anurea*, 2. Crustacea, *Daphnia*, .02. Miscellaneous, *Acarina*, .02; *Zoöglœa*, 60. Total, 1376.

No 15502. Diatomaceæ, *Fragilaria*, 60; *Melosira*, 174, *Meridion*, 1; *Stauroneis*, 2; *Synedra*, 10. Cyanophyceæ, *Anabæna*, 960; *Clathrocystis*, 1; *Microcystis*, 2; *Oscillaria*, 2. Algæ, *Chlorococcus*, 2; *Cosmarium*, 1; *Protococcus*, 15; *Raphidium*, 2; *Scenedesmus*, 2; *Staurastrum*, 9; *Zoöspores*, 168. Fungi, *Crenothrix*, 13. Infusoria, *Dinobryon*, 3; *Peridinium*, 3; *Synura*, 21; *Uroglena*, 52. Vermes, *Anurea*, 2; *Rotifer*, 1. Crustacea, *Cyclops*, .02; *Daphnia*, .06. Miscellaneous, *Acarina*, .04; *Zoöglœa*, 5. Total, 1511.

Water Supply of Westfield.

The advice of the State Board of Health to the town of Westfield relative to taking the water of Munn Brook in Granville as an additional water supply for Westfield may be found on page 52 of this volume.

Chemical Examination of Water from the Westfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14916	Aug. 25	Distinct.	Cons.	.60	2.85	1.60	.0046	.0234	.0202	.0032	.11	.0000	.0000	.7254	0.1
14917	Aug. 25	Slight.	Slight, yellow.	.70	3.15	1.50	.0028	.0160	.0126	.0034	.14	.0100	.0001	.6630	0.3
14918	Aug. 27	Slight.	Slight.	.88	3.35	1.50	.0012	.0172	.0150	.0022	.10	.0120	.0002	.6162	1.1

Odor of the first sample, distinctly vegetable and unpleasant; of the second, distinctly vegetable; of the last, faintly vegetable.—— The first sample was collected from the storage reservoir at its centre; the second, from the distributing reservoir near the gate-house; and the last, from a faucet in the town.

Microscopical Examination of Water from the Westfield Water Works.

[Number of organisms per cubic centimeter.]

	1895. Aug.	1895. Aug.	1895. Aug.
Day of examination,	29	29	29
Number of sample,	14916	14917	14918
PLANTS.			
Diatomaceæ,	132	1	4
Asterionella,	44	0	3
Cyclotella,	0	1	0
Fragilaria,	2	0	0
Tabellaria,	86	0	1
Cyanophyceæ,	27	0	0
Anabæna,	26	0	0
Microcystis,	1	0	0
Algæ,	4	2	2
Protococcus,	0	2	0
Raphidium,	4	0	0
Scenedesmus,	0	0	1
Staurastrum,	0	0	1
Fungi,	0	18	3
Crenothrix,	0	17	3
Molds,	0	1	0

WESTFIELD.

Microscopical Examination of Water from the Westfield Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1895.		
	Aug.	Aug.	Aug.
ANIMALS.			
Infusoria,	16	1	2
Dinobryon cases,	11	0	0
Peridinium,	3	0	1
Tintinnidium,	1	0	0
Trachelomonas,	1	1	0
Vorticella,	0	0	1
Vermes, Anurea,	1	0	0
Crustacea, Bosmina,	.10	0	0
Miscellaneous,	880	580	0
Acarina,	.08	0	0
Zoöglœa,	880	580	0
TOTAL,	1,060	602	11

WESTON.

The advice of the State Board of Health to the petitioners for incorporation as the Weston Water and Electric Company relative to taking a water supply for the town of Weston from springs in that town may be found on pages 52 and 53 of this volume. The results of analyses of samples of water collected from tubular wells near the source of Cherry Brook and from tubular wells near Central Avenue are given in the following table.

Chemical Examination of Water from Tubular Test Wells in Weston.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14237	May 2	Slight, clayey.	Slight, clayey.	.04	8.90	.0012	.0020	.70	.2060	.0002	.0962	3.2	.0100
14574	July 1	Distinct, clayey.	Cons., earthy.	.00	5.00	.0000	.0002	.44	.0500	.0000	.0395	1.9	.0120

Odor of the first sample, none. The second sample had an odor of machine oil. —— The first sample was collected from a driven well near the upper source of Cherry Brook, and the second from a driven well in a meadow north of Central Avenue.

Microscopical Examination.

No. 14237. Fungi, *Crenothrix*, 1. Miscellaneous, *Zoöglœa*, 68. Total, 69.

No. 14574. No organisms.

Water Supply of West Springfield.

In the spring of 1895 the works for supplying West Springfield with water were enlarged by the construction of a pipe line to divert the water from springs in the valley of Block Brook into the brook supplying West Springfield Reservoir.

The water of the springs is collected in a small wooden collecting well located on the easterly side of Block Brook, about three-quarters of a mile above the point where it is crossed by the Westfield road. The water flows by gravity from the well to the brook which supplies the West Springfield Reservoir.

Water Supply of Weymouth.

Chemical Examination of Water from Great Pond, in Weymouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14046	Mar. 27	V. slight.	V. slight.	0.90	4.05	1.80	.0004	.0198	.0186	.0012	.58	.0030	.0000	0.8470	1.3
14532	June24	Distinct.	Slight, yellow.	0.73	4.00	1.80	.0014	.0218	.0200	.0018	.60	.0030	.0000	0.7815	0.5
15275	Sept.26	V. slight.	Slight, brown.	0.40	3.70	1.75	.0000	.0156	.0146	.0010	.59	.0070	.0000	0.4758	0.3
15788	Dec. 23	V. slight.	V. slight.	1.25	4.55	2.60	.0002	.0214	.0202	.0012	.46	.0030	.0000	1.0780	0.5
Av.	....	....	....	0.82	4.07	1.99	.0005	.0196	.0183	.0013	.56	.0040	.0000	0.7956	0.6

Averages by Years.

-	1887*	-	-	0.93	4.08	1.75	.0007	.0219	-	-	.47	.0030	-	-	-
-	1888†	-	-	0.88	4.15	1.94	.0020	.0225	-	-	.48	.0074	.0000	-	-
-	1889‡	-	-	1.40	-	-	.0000	.0230	.0220	.0010	-	.0040	.0000	-	-
-	1892	-	-	0.94	3.82	1.86	.0000	.0173	.0156	.0017	.51	.0077	.0000	-	0.4
-	1893	-	-	0.76	3.86	1.66	.0003	.0163	.0139	.0025	.57	.0008	.0000	.6847	0.5
-	1894	-	-	0.77	3.99	1.60	.0003	.0169	.0156	.0013	.61	.0015	.0000	.6703	0.7
-	1895	-	-	0.82	4.07	1.99	.0005	.0196	.0183	.0013	.56	.0040	.0000	.7956	0.6

* June to December. † January to May. ‡ July.

Note to analyses of 1895: Odor of the third sample, none; of the others, distinctly vegetable. — The samples were collected from faucets in the town.

WEYMOUTH.

Microscopical Examination of Water from Great Pond, in Weymouth.

[Number of organisms per cubic centimeter.]

	1895.			
	Mar.	July.	Oct.	Dec.
Day of examination,	29	26	1	24
Number of sample,	14046	14532	15275	15788
PLANTS.				
Diatomaceæ,	103	122	0	0
Asterionella,	96	120	0	0
Synedra,	0	2	0	0
Tabellaria,	7	0	0	0
Algæ,	0	12	0	2
Protococcus,	0	12	0	0
Zoöspores,	0	0	0	2
Fungi, Crenothrix,	0	34	60	0
ANIMALS.				
Infusoria,	138	1,880	0	0
Dinobryon,	2	1,360	0	0
Dinobryon cases,	136	520	0	0
TOTAL,	241	2,048	60	2

WATER SUPPLY OF WILLIAMSTOWN. — WILLIAMSTOWN WATER COMPANY.

The advice of the State Board of Health to the Williamstown Water Company, relative to taking the water of Flora Glen Brook as a source of additional water supply for the town, may be found on page 53 of this volume.

Chemical Examination of Water from Cold Spring Reservoir and from Sherman Spring, Williamstown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1895.												
14904	Aug. 23	Slight.	Slight.	.02	13.70	.0000	.0000	.10	.0480	.0000	.0234	11.9	.0040
14905	Aug. 23	None.	None.	.00	9.90	.0000	.0000	.10	.0150	.0000	.0000	7.9	.0030

Odor, none. —— The first sample was collected from Cold Spring Reservoir, and the second from Sherman Spring.

Microscopical Examination.

No. 14904. No organisms.
No. 14905. Diatomaceæ, *Meridion*, 7.

WILLIAMSTOWN.

Chemical Examination of Water from Flora Glen Brook, Williamstown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
15271	1895. Sept.27	V. slight.	V. slight.	.00	6.55	0.35	.0000	.0020	.0010	.0010	.08	.0030	.0000	.0819	4.

Odor, none.——The sample was collected from the brook, above the site of a proposed reservoir.

Microscopical Examination.

Fungi, *Molds*, 2.

Winchendon.

The advice of the State Board of Health to the town of Winchendon with regard to the use of water from the ground in Prentiss Meadow as a source of water supply for the town may be found on pages 54 to 57 of this volume.

Water Supply of Winchester.

During the last two years there has been a marked increase in the amount of chlorine present in the water of North Reservoir, which is shown in the table of averages by years of chemical examinations of water from this source, given below. This increase is probably due to the increase in population upon the portion of the watershed of the reservoir within the village of Stoneham. It was found by examination, in 1895, that this portion of the watershed contained 400 people.

WINCHESTER.

Chemical Examination of Water from the North Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13586	Jan. 2	V. slight.	V. slight.	.07	7.00	1.90	.0040	.0226	.0208	.0018	1.04	.0150	.0001	.2656	3.0
13764	Feb. 5	V. slight.	Slight.	.12	5.40	1.35	.0084	.0136	.0122	.0014	0.78	.0200	.0000	.2473	2.1
13922	Mar. 5	V. slight.	Cons.	.10	7.00	2.15	.0092	.0158	.0140	.0018	1.03	.0350	.0007	.3118	2.7
14081	Apr. 2	Slight.	V. slight.	.05	5.90	1.80	.0010	.0166	.0140	.0026	0.79	.0300	.0001	.1963	2.3
14246	May 6	Distinct.	Cons.	.12	6.50	2.25	.0006	.0170	.0142	.0028	0.89	.0280	.0002	.2502	2.7
14411	June 4	Slight.	Slight.	.08	6.25	2.35	.0002	.0188	.0162	.0026	0.89	.0190	.0003	.2698	2.5
14589	July 9	Distinct.	Slight.	.10	5.95	1.85	.0012	.0238	.0188	.0050	0.88	.0130	.0001	.3081	2.5
14772	Aug. 6	Distinct.	Slight.	.10	6.80	2.20	.0006	.0240	.0188	.0052	0.90	.0120	.0000	.3354	2.9
14958	Sept. 3	Distinct.	Slight, brown.	.10	7.20	2.25	.0000	.0198	.0168	.0030	0.93	.0000	.0001	.2911	2.6
15298	Oct. 2	Distinct.	Cons., brown.	.10	6.90	2.00	.0006	.0220	.0190	.0030	0.93	.0000	.0000	.2792	2.6
15476	Nov. 5	Distinct.	Slight, green.	.15	6.75	2.10	.0020	.0248	.0202	.0046	0.91	.0280	.0001	.3822	2.7
15660	Dec. 3	Distinct, green.	Cons., yellow.	.20	6.35	2.45	.0010	.0254	.0184	.0070	0.90	.0200	.0002	.3572	2.6
Av.	....	....	....	.11	6.50	2.05	.0024	.0203	.0169	.0034	0.91	.0183	.0002	.2912	2.6

Averages by Years.

-	1887*	-	-	.11	5.08	1.18	.0015	.0196	-	-	.53	.0037	-	-	-
-	1888	-	-	.15	4.93	1.24	.0045	.0273	-	-	.47	.0131	.0003	-	-
-	1889	-	-	.13	4.52	1.18	.0022	.0223	.0176	.0047	.47	.0105	.0003	-	-
-	1890	-	-	.09	5.30	1.31	.0017	.0201	.0160	.0041	.52	.0153	.0002	-	2.7
-	1891	-	-	.10	4.94	1.39	.0034	.0222	.0169	.0053	.51	.0152	.0001	-	2.1
-	1892	-	-	.06	5.23	1.59	.0058	.0217	.0177	.0040	.60	.0192	.0002	-	2.5
-	1893	-	-	.07	5.13	1.62	.0055	.0252	.0172	.0080	.59	.0127	.0002	.2718	2.3
-	1894	-	-	.09	5.85	1.86	.0017	.0198	.0160	.0038	.82	.0076	.0001	.2491	2.5
-	1895	-	-	.11	6.50	2.05	.0024	.0203	.0169	.0034	.91	.0183	.0002	.2912	2.6

* June to December.

NOTE to analyses of 1895: Odor, in January, none; at other times, vegetable; stronger during the latter half of the year than during the first half.—— The samples were collected from the reservoir.

WINCHESTER.

Microscopical Examination of Water from the North Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
Day of examination,	4	6	7	3	7	5	10	8	5	3	6	4
Number of sample,	13586	13764	13922	14081	14246	14411	14589	14772	14958	15298	15476	15660
PLANTS.												
Diatomaceæ,	**0**	**0**	**pr.**	**1**	**560**	**123**	**18**	**101**	**38**	**318**	**3,369**	**4,973**
Asterionella,	0	0	0	0	232	23	16	88	28	160	3,328	4,960
Cyclotella,	0	0	pr.	0	52	74	0	0	3	8	1	3
Cymbella,	0	0	0	0	3	0	2	0	1	0	0	0
Fragilaria,	0	0	0	0	0	0	0	0	0	0	40	0
Melosira,	0	0	0	0	0	2	0	9	0	142	0	0
Navicula,	0	0	0	0	6	1	0	2	1	4	0	0
Synedra,	0	0	0	1	236	10	0	1	5	4	0	0
Tabellaria,	0	0	0	0	31	13	0	1	0	0	0	10
Cyanophyceæ,	**0**	**1**	**0**	**0**	**0**	**0**	**366**	**122**	**4**	**8**	**62**	**8**
Anabæna,	0	0	0	0	0	0	0	78	0	2	0	0
Clathrocystis,	0	0	0	0	0	0	360	44	0	0	1	0
Cœlosphærium,	0	1	0	0	0	0	6	0	0	0	1	0
Microcystis,	0	0	0	0	0	0	0	0	4	6	7	8
Nostoc,	0	0	0	0	0	0	0	0	0	0	53	0
Algæ,	**0**	**0**	**pr.**	**2**	**32**	**39**	**126**	**12**	**59**	**74**	**16**	**23**
Chlorococcus,	0	0	0	0	0	29	0	0	0	4	2	0
Closterium,	0	0	0	2	23	2	0	0	1	0	0	0
Cœlastrum,	0	0	0	0	0	0	0	0	0	0	1	7
Protococcus,	0	0	pr.	0	0	7	126	0	0	0	0	0
Raphidium,	0	0	0	0	1	0	0	12	56	68	13	16
Scenedesmus,	0	0	0	0	8	1	0	0	2	2	0	0
Fungi, Crenothrix,	**0**	**0**	**pr.**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**5**	**0**
ANIMALS.												
Infusoria,	**2**	**3**	**pr.**	**717**	**156**	**181**	**0**	**7**	**8**	**116**	**2**	**4**
Ciliated infusorian,	0	0	0	50	0	0	0	0	0	0	0	0
Dinobryon,	0	0	0	600	0	17	0	0	0	22	0	0
Dinobryon cases,	0	0	0	0	156	149	0	0	0	72	1	0
Mallomonas,	0	0	0	0	0	15	0	0	0	4	0	1
Monas,	0	0	0	50	0	0	0	0	0	0	0	0
Peridinium,	1	3	pr.	17	0	0	0	6	7	0	0	0
Trachelomonas,	1	0	0	0	0	0	0	1	1	18	1	3
Vermes, Anurea,	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
Crustacea, Cyclops,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.12**
Miscellaneous, Zoöglœa,	**0**	**0**	**6**	**0**	**68**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL,	2	4	6	720	818	343	510	243	110	516	3,454	5,008

WINCHESTER.

Chemical Examination of Water from the South Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13588	Jan. 2	V. slight.	Slight.	.43	5.70	1.95	.0142	.0306	.0266	.0040	.52	.0040	.0001	.5837	2.6
13766	Feb. 5	Slight.	Slight.	.45	4.80	1.35	.0086	.0202	.0188	.0014	.43	.0070	.0000	.3105	2.1
13924	Mar. 5	V. slight.	V. slight.	.10	3.85	1.40	.0150	.0206	.0198	.0008	.43	.0070	.0000	.4004	1.8
14083	Apr. 2	V. slight.	V. slight.	.07	3.85	1.30	.0014	.0202	.0186	.0016	.30	.0080	.0000	.2964	1.3
14247	May 6	Slight.	Cons.	.20	4.30	2.15	.0014	.0268	.0248	.0020	.38	.0080	.0001	.4196	1.9
14413	June 4	Distinct.	Slight.	.10	4.00	1.85	.0008	.0294	.0232	.0062	.40	.0050	.0000	.4256	1.7
14591	July 9	Slight.	Slight.	.12	4.30	1.85	.0004	.0266	.0238	.0028	.40	.0070	.0000	.4187	1.7
14774	Aug. 6	Slight.	Slight.	.12	4.45	1.65	.0006	.0290	.0246	.0044	.43	.0080	.0000	.4368	2.1
14959	Sept. 3	Distinct.	Slight.	.13	5.15	2.05	.0000	.0266	.0224	.0042	.44	.0000	.0003	.4297	1.7
15300	Oct. 2	Slight.	Slight.	.12	4.40	2.00	.0000	.0258	.0220	.0038	.44	.0030	.0000	.4118	1.7
15477	Nov. 5	Decided, green.	Slight, green.	.20	4.25	1.75	.0046	.0288	.0242	.0046	.42	.0250	.0001	.4017	2.1
15662	Dec. 3	Slight.	Slight.	.17	4.20	1.90	.0000	.0284	.0224	.0060	.36	.0020	.0000	.3900	1.7
Av.	....	....	....	.18	4.44	1.77	.0039	.0261	.0226	.0035	.41	.0070	.0001	.4104	1.9

Averages by Years.

-	1891*	-	-	.60	5.73	2.09	.0110	.0486	.0361	.0125	.40	.0094	.0006	-	2.3
-	1892	-	-	.51	5.17	2.04	.0055	.0392	.0318	.0074	.38	.0118	.0002	-	2.2
-	1893	-	-	.34	4.78	1.86	.0064	.0291	.0216	.0075	.36	.0093	.0002	.4891	2.1
-	1894	-	-	.18	4.56	1.76	.0049	.0267	.0232	.0035	.41	.0024	.0001	.4452	1.9
-	1895	-	-	.18	4.44	1.77	.0039	.0261	.0226	.0035	.41	.0070	.0001	.4104	1.9

* August to December.

NOTE to analyses of 1895: Odor, until September, faintly vegetable; in September, distinctly vegetable; in October, unpleasant; in November and December, distinctly disagreeable.—— The samples were collected from the reservoir, near the gate-house.

WINCHESTER.

Microscopical Examination of Water from the South Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	4	6	7	3	7	5	10	8	5	6	3	4
Number of sample,	13588	13766	13924	14083	14247	14413	14591	14774	14959	15300	15477	15662
PLANTS.												
Diatomaceæ,	**0**	**2**	**0**	**6**	**875**	**1,021**	**0**	**7**	**51**	**432**	**236**	**519**
Asterionella,	0	0	0	0	49	13	0	0	14	432	236	512
Cyclotella,	0	0	0	0	0	0	0	0	36	0	0	0
Navicula,	0	1	0	0	2	2	0	3	0	0	0	0
Synedra,	0	1	0	0	192	2	0	3	1	0	0	4
Tabellaria,	0	0	0	6	632	1,004	0	1	0	0	0	3
Cyanophyceæ,	**0**	**1**	**2**	**0**	**0**	**0**	**44**	**4**	**46**	**1**	**4**	**0**
Anabæna,	0	0	0	0	0	0	5	4	46	1	0	0
Cœlosphærium,	0	1	2	0	0	0	3	0	0	0	2	0
Microcystis,	0	0	0	0	0	0	36	0	0	0	2	0
Algæ,	**0**	**0**	**0**	**6**	**134**	**616**	**317**	**32**	**6**	**99**	**276**	**355**
Closterium,	0	0	0	0	128	612	0	0	0	0	0	0
Protococcus,	0	0	0	4	1	4	296	30	0	11	0	0
Raphidium,	0	0	0	0	0	0	20	2	6	88	0	24
Scenedesmus,	0	0	0	0	4	0	1	0	0	0	0	11
Zoöspores,	0	0	0	2	1	0	0	0	0	0	276	320
ANIMALS.												
Infusoria,	**21**	**22**	**1**	**2**	**315**	**10**	**69**	**52**	**2**	**5**	**0**	**4**
Ceratium,	0	0	0	0	0	0	0	0	1	1	0	0
Dinobryon,	0	0	0	0	78	0	68	0	0	0	0	0
Dinobryon cases,	0	20	0	0	200	0	0	32	0	0	0	0
Mallomonas,	7	0	0	0	2	0	0	4	0	0	0	4
Peridinium,	13	0	0	0	0	0	0	11	1	0	0	0
Trachelomonas,	1	2	1	2	35	10	1	5	0	0	0	0
Vorticella,	0	0	0	0	0	0	0	0	0	4	0	0
Vermes,	**0**	**1**	**1**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
Anurea,	0	1	1	0	1	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	1	0	0	0	0	0	1	0
Rotifer,	0	0	0	0	4	0	0	0	0	0	1	0
Miscellaneous, Zoöglœa,	**0**	**0**	**6**	**0**	**20**	**0**	**0**	**0**	**0**	**0**	**100**	**0**
TOTAL,	21	26	10	14	1,350	1,647	430	95	105	537	618	878

WINCHESTER.

Chemical Examination of Water from the Middle Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13587	Jan. 2	Distinct.	Slight.	.72	6.60	3.95	.0158	.0928	.0758	.0170	.50	.0080	.0000	1.0241	1.8
13765	Feb. 5	Slight.	Cons.	.20	4.05	1.00	.0062	.0342	.0176	.0166	.44	.0070	.0000	0.3263	1.1
13923	Mar. 5	Distinct, green.	Cons., green.	.60	5.90	3.30	.0152	.0880	.0566	.0314	.48	.0070	.0000	0.9278	1.4
14082	Apr. 2	Decided.	Cons., gray.	.08	2.05	0.90	.0022	.0610	.0258	.0352	.16	.0040	.0000	0.2032	0.2
14248	May 6	Distinct.	Cons., green.	.48	4.70	2.80	.0014	.0670	.0410	.0260	.42	.0100	.0004	0.7161	1.3
14412	June 4	Decided.	Slight, brown.	.58	5.80	3.75	.0078	.1156	.0606	.0550	.39	.0040	.0000	0.8664	1.1
14590	July 9	Decided, green.	Cons., green.	.50	5.10	3.05	.0014	.0688	.0478	.0210	.41	.0000	.0000	0.7979	1.4
14773	Aug. 6	Decided.	Slight.	.37	5.20	2.40	.0070	.0522	.0480	.0042	.47	.0100	.0002	0.7722	1.6
14960	Sept. 3	Decided, green.	Cons., yellow.	.30	4.85	2.20	.0036	.0630	.0392	.0238	.45	.0030	.0003	0.7045	1.3
15299	Oct. 2	Decided, green	Cons., green.	.37	4.70	2.40	.0000	.0752	.0468	.0284	.46	.0030	.0000	0.6903	1.7
15478	Nov. 5	Decided, green.	Slight, green.	.35	4.50	2.45	.0044	.0600	.0482	.0118	.42	.0140	.0001	0.6568	1.3
15661	Dec. 3	Decided, green.	Cons., green.	.42	4.60	2.75	.0002	.0532	.0466	.0066	.36	.0080	.0000	0.7605	1.1
Av.	1895	....	....	.41	4.84	2.58	.0054	.0693	.0462	.0231	.41	.0065	.0001	0.7038	1.3
Av.	1894	....	....	.79	5.48	3.02	.0045	.0723	.0485	.0238	.44	.0032	.0001	0.8645	1.5

NOTE to analyses of 1895: Odor, generally distinctly vegetable, frequently becoming stronger on heating. In April the odor was decidedly oily on heating.—The samples were collected from the reservoir, above the dam.

There is no way of drawing water directly from this reservoir for the supply of the town. The overflow from it passes into the South Reservoir.

WINCHESTER.

Microscopical Examination of Water from the Middle Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, . .	4	6	7	3	7	5	10	8	5	3	6	4
Number of sample, . .	13587	13765	13923	14082	14248	14412	14590	14773	14960	15299	15478	15661
PLANTS.												
Diatomaceæ, . . .	**56**	**9**	**18**	**480**	**789**	**0**	**16,700**	**10**	**4**	**750**	**4**	**22**
Asterionella, . .	0	0	0	0	0	0	0	0	0	0	0	12
Fragilaria, . . .	0	0	0	0	1	0	16,400	8	0	0	0	0
Synedra, . . .	56	9	18	480	788	0	300	2	4	750	4	8
Tabellaria, . . .	0	0	0	0	0	0	0	0	0	0	0	2
Cyanophyceæ, . .	**36**	**28**	**184**	**60**	**0**	**2,850**	**1,450**	**24**	**0**	**352**	**44**	**8**
Anabæna, . . .	0	0	0	0	0	2,650	0	0	0	0	0	0
Clathrocystis, . .	0	0	0	0	0	0	650	0	0	2	18	2
Cœlosphærium, . .	36	28	184	60	0	200	0	0	0	50	16	6
Microcystis, . .	0	0	0	0	0	0	800	0	0	300	10	0
Oscillaria, . . .	0	0	0	0	0	0	0	24	0	0	0	0
Algæ, ...	**0**	**0**	**2**	**0**	**195**	**55**	**16,050**	**94**	**642**	**2,300**	**1,676**	**5,262**
Arthrodesmus, . .	0	0	0	0	0	50	0	0	0	0	0	0
Cœlastrum, . . .	0	0	0	0	0	0	0	0	0	650	0	0
Cosmarium, . .	0	0	0	0	0	0	16,000	3	0	0	0	0
Glœocapsa, . . .	0	0	0	0	0	0	0	4	0	50	0	0
Pediastrum, . . .	0	0	0	0	2	0	0	0	2	100	4	0
Protococcus, . .	0	0	0	0	76	0	0	6	108	100	0	0
Raphidium, . . .	0	0	0	0	61	0	50	76	336	0	1,324	2,360
Scenedesmus, . .	0	0	0	0	36	0	0	3	4	0	312	2,736
Selenastrum, . .	0	0	0	0	0	0	0	0	0	0	26	160
Staurastrum, . .	0	0	0	0	0	0	0	2	192	1,300	10	0
Volvox, . . .	0	0	0	0	0	5	0	0	0	0	0	0
Zoöspores, . . .	0	0	2	0	20	0	0	0	0	100	0	6
Fungi, Crenothrix, .	**0**	**0**	**0**	**0**	**0**	**0**	**50**	**19**	**0**	**0**	**0**	**0**
ANIMALS.												
Rhizopoda, Arcella, .	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Infusoria, ...	**50**	**1,049**	**470**	**1,191**	**306**	**0**	**2,000**	**96**	**808**	**850**	**129**	**166**
Ciliated infusorian, .	0	0	0	0	0	0	0	0	0	600	0	0
Dinobryon, . . .	0	2	8	1,040	0	0	0	0	0	0	0	50
Dinobryon cases, .	0	3	72	0	0	0	0	0	240	0	0	0
Euglena, . . .	0	5	88	100	0	0	0	0	0	0	4	4
Mallomonas, . .	0	0	6	0	1	0	0	0	488	0	0	0
Monas, ...	0	0	0	6	0	0	200	0	0	100	1	0
Paramæcium, . .	0	0	0	0	0	0	0	0	0	50	0	0
Peridinium, . . .	44	19	72	5	116	0	0	44	22	0	64	108
Trachelomonas, . .	6	1,020	224	40	188	0	1,800	52	48	100	60	4
Vorticella, . . .	0	0	0	0	1	0	0	0	10	0	0	0
Vermes, ...	**2**	**0**	**4**	**0**	**1**	**0**	**0**	**0**	**4**	**0**	**36**	**24**
Anurea, ...	0	0	0	0	0	0	0	0	4	0	36	24
Polyarthra, . . .	2	0	4	0	1	0	0	0	0	0	0	0
Crustacea, ...	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**.04**	**0**
Bosmina, ...	0	0	0	0	0	2	0	0	0	0	0	0
Daphnia, ...	0	0	0	0	0	1	0	0	0	0	.04	0
Miscellaneous, ...	**0**	**0**	**0**	**0**	**24**	**0**	**0**	**.04**	**0**	**0**	**.04**	**0**
Acarina, ...	0	0	0	0	0	0	0	.04	0	0	.04	0
Zoöglœa, ...	0	0	0	0	24	0	0	0	0	0	0	0
TOTAL, ...	144	1,086	678	1,731	1,315	2,908	36,250	243	1,458	4,252	1,889	5,484

WOBURN.

Water Supply of Woburn.

Chemical Examination of Water from the Filter-gallery of the Woburn Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1895.												
13606	Jan. 7	None.	None.	.01	10.60	.0028	.0042	1.90	.0240	.0000	.0507	5.0	.0000
13622	Jan. 7	None.	V. slight.	.02	11.00	.0032	.0046	1.98	.0260	.0000	.0507	5.0	.0000
13623	Jan. 8	None.	None.	.02	11.50	.0028	.0044	1.91	.0240	.0000	.0507	5.0	.0000
13653	Jan. 14	None.	V. slight.	.03	10.70	.0068	.0030	1.76	.0120	.0000	.0671	4.9	.0000
13727	Jan. 28	None.	None.	.00	10.10	.0018	.0026	1.72	.0150	.0000	.0395	4.7	.0000
13728	Jan. 28	None.	None.	.03	11.10	.0036	.0026	1.88	.0300	.0002	.0379	4.9	.0000
13729	Jan. 28	None.	None.	.03	11.00	.0030	.0012	1.94	.0200	.0005	.0490	5.1	.0000
13842	Feb. 19	None.	None.	.03	10.80	.0030	.0022	1.78	.0220	.0000	.0312	4.7	.0000
13998	Mar. 19	None.	V. slight.	.01	10.40	.0018	.0020	1.76	.0230	.0000	.0592	4.9	.0010
14172	Apr. 17	None.	None.	.01	11.10	.0022	.0012	1.79	.0280	.0000	.0711	4.4	.0000
14334	May 21	None.	None.	.02	10.65	.0024	.0016	1.73	.0180	.0000	.0355	4.6	.0020
14503	June 19	None.	None.	.00	11.20	.0026	.0018	1.72	.0230	.0000	.0156	5.0	.0010
14698	July 23	None.	None.	.01	10.95	.0022	.0018	1.76	.0280	.0000	.0600	5.4	.0190
14854	Aug. 19	None.	None.	.00	11.10	.0044	.0028	1.70	.0170	.0000	.0624	5.4	.0000
15171	Sept. 16	None.	None.	.00	11.95	.0044	.0020	1.73	.0100	.0000	.0640	4.7	.0015
15359	Oct. 14	None.	None.	.01	10.20	.0032	.0020	1.67	.0150	.0000	.0936	4.9	.0010
15556	Nov. 18	None.	None.	.00	10.00	.0038	.0022	1.72	.0156	.0000	.0686	4.6	.0015
15741	Dec. 17	None.	V. slight.	.01	10.60	.0038	.0038	1.71	.0240	.0000	.0731	5.0	.0010
Av.*	....	....	....	.01	10.82	.0031	.0022	1.74	.0204	.0000	.0570	4.9	.0023

Averages by Years.

-	1887†	-	-	.00	12.06	-	.0028	2.40	.0314	-	-	-	-
-	1888	-	-	.00	12.00	.0012	.0032	2.50	.0346	.0000	-	-	-
-	1889	-	-	.00	10.84	.0010	.0022	2.07	.0372	.0000	-	-	-
-	1890	-	-	.01	11.06	.0012	.0023	1.91	.0481	.0000	-	5.0	-
-	1891	-	-	.00	10.85	.0008	.0015	1.79	.0668	.0000	-	4.9	-
-	1892	-	-	.00	11.27	.0012	.0024	1.95	.0542	.0000	-	5.1	-
-	1893	-	-	.00	11.50	.0022	.0018	2.04	.0447	.0000	.0517	5.3	.0004
-	1894	-	-	.01	11.02	.0026	.0018	1.94	.0262	.0000	.0501	5.0	.0021
-	1895	-	-	.01	10.82	.0031	.0022	1.74	.0204	.0000	.0570	4.9	.0023

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average. † June to December.

Note to analyses of 1895: Odor, none. —— The samples were collected from the filter-gallery.

Microscopical Examination.

An insignificant number of organisms was found in the samples collected in January, February, May and October, and no organisms in the other samples.

Chemical Examination of Water from Horn Pond, Woburn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13652	Jan. 14	Slight.	Slight.	.45	8.85	2.45	.0196	.0326	.0210	.0116	1.32	.0970	.0002	.5372	3.0
13841	Feb. 19	Distinct.	Slight.	.45	9.75	2.70	.0142	.0218	.0170	.0048	1.50	.1100	.0004	.4173	3.5
14171	Apr. 17	Slight.	Cons., green.	.30	9.55	2.90	.0000	.0272	.0178	.0094	1.55	.0830	.0030	.4582	3.4
14333	May 21	Decided.	Cons., green.	.40	9.15	3.20	.0004	.0342	.0202	.0140	1.42	.0620	.0020	.5214	3.0
14502	June 19	Distinct.	Slight.	.38	9.65	4.40	.0034	.0284	.0248	.0036	1.54	.0400	.0020	.4228	3.5
14677	July 23	Slight.	Cons.	.35	9.45	2.30	.0000	.0314	.0190	.0124	1.65	.0300	.0022	.4350	3.6
14853	Aug. 19	Distinct, green.	Cons., green.	.20	9.25	2.15	.0000	.0342	.0210	.0132	1.66	.0080	.0015	.4836	3.6
15170	Sept. 16	Decided, green.	Slight, green.	.30	9.95	2.25	.0002	.0290	.0202	.0088	1.80	.0030	.0003	.4696	3.4
15358	Oct. 14	Distinct.	Cons.	.23	9.25	2.30	.0462	.0328	.0222	.0106	1.74	.0140	.0005	.4485	3.6
15555	Nov. 18	Distinct, green.	Slight.	.40	9.40	3.00	.0092	.0322	.0206	.0116	1.47	.0280	.0018	.5834	3.2
15740	Dec. 17	Slight.	Slight.	.48	9.45	3.55	.0030	.0232	.0222	.0010	1.14	.1050	.0014	.5582	3.1
Av.	....	....	....	.36	9.43	2.84	.0087	.0297	.0205	.0092	1.58	.0523	.0014	.4850	3.4

Averages by Years.

-	1887*	-	-	.44	13.79	2.19	.0149	.0480	-	-	3.74	.0224	.0014	-	-
-	1888	-	-	.32	11.28	1.71	.0186	.0383	-	-	2.98	.0398	.0015	-	-
-	1889	-	-	.30	8.37	2.03	.0092	.0376	.0216	.0160	1.98	.0498	.0015	-	-
-	1890	-	-	.27	10.76	2.07	.0080	.0368	.0205	.0163	1.91	.0581	.0008	-	3.4
-	1891	-	-	.22	8.90	2.06	.0129	.0453	.0237	.0216	1.76	.0502	.0009	-	2.9
-	1892	-	-	.25	10.57	2.13	.0110	.0358	.0216	.0142	2.42	.0821	.0008	-	3.3
-	1893	-	-	.30	9.83	2.51	.0061	.0455	.0247	.0208	2.10	.0472	.0009	.4530	3.2
-	1894	-	-	.33	9.03	1.98	.0065	.0292	.0184	.0108	1.84	.0404	.0009	.4038	3.3
-	1895	-	-	.36	9.43	2.84	.0087	.0297	.0205	.0092	1.53	.0523	.0014	.4850	3.4

* June to December.

NOTE to analyses of 1895: Odor, distinctly vegetable; often also mouldy or unpleasant. —— The samples were collected from the pond at its outlet, 1 foot beneath the surface.

WOBURN.

Microscopical Examination of Water from Horn Pond, Woburn.

[Number of organisms per cubic centimeter.]

	1895.										
	Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	18	21	20	24	20	17	15	20	18
Number of sample,	13652	13841	14171	14333	14502	14677	14853	15170	15358	15555	15740
PLANTS.											
Diatomaceæ,	34	6	2,022	7,530	1	50	59	1,020	68	525	223
Asterionella,	33	3	1,920	3,200	0	0	0	0	12	104	40
Cyclotella,	0	pr.	0	0	0	0	24	1,020	3	0	2
Diatoma,	0	1	0	0	0	0	0	0	14	8	3
Fragilaria,	0	0	0	4,320	0	50	33	0	9	0	0
Melosira,	0	1	96	0	0	0	0	0	29	268	105
Synedra,	0	1	6	10	1	0	2	0	0	128	73
Tabellaria,	1	pr.	0	0	0	0	0	0	1	17	0
Cyanophyceæ,	1	0	0	0	15	28	675	25	4	0	0
Anabæna,	0	0	0	0	0	0	43	23	2	0	0
Chroöcoccus,	0	0	0	0	0	0	624	0	0	0	0
Clathrocystis,	0	0	0	0	0	28	0	2	2	0	0
Cœlosphærium,	1	0	0	0	15	0	2	0	0	0	0
Microcystis,	0	0	0	0	0	0	6	0	0	0	0
Algæ,	1	1	4	8	568	282	1,928	225	126	34	12
Arthrodesmus,	0	0	0	0	0	0	188	0	0	1	0
Chlorococcus,	0	1	0	0	0	0	228	0	0	0	0
Cosmarium,	0	0	0	2	0	60	0	180	108	1	0
Pandorina,	0	0	0	0	0	48	0	0	0	0	0
Protococcus,	0	0	0	0	520	102	1,008	0	4	2	0
Raphidium,	0	0	0	0	0	2	0	8	0	28	0
Scenedesmus,	1	0	1	4	44	56	504	7	12	0	11
Staurastrum,	0	0	0	2	4	14	0	28	2	0	0
Zoöspores,	0	0	3	0	0	0	0	2	0	2	1
Fungi, Crenothrix,	52	2	4	0	0	4	0	0	1	0	0
ANIMALS.											
Rhizopoda, Actinophrys,	0	0	0	0	0	4,800	0	0	0	0	0
Infusoria,	11	4	7	0	0	48	377	1	30	16	0
Cryptomonas,	9	pr.	0	0	0	0	0	0	0	0	0
Euglena,	0	0	0	0	0	0	0	0	24	0	0
Mallomonas,	0	0	5	0	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	20	1	0	2	0
Peridinium,	0	1	2	0	0	48	357	0	2	4	0
Trachelomonas,	2	3	0	0	0	0	0	0	4	10	0
Vermes,	0	0	1	14	0	2	2	2	4	0	0
Anurea,	0	0	0	6	0	2	1	0	1	0	0
Polyarthra,	0	0	0	4	0	0	1	0	0	0	0
Rotatorian ova,	0	0	1	4	0	0	0	2	3	0	0
Miscellaneous, Zoöglœa,	72	3	0	0	0	0	0	72	160	100	60
TOTAL,	171	16	2,038	7,552	584	5,214	3,041	1,345	393	675	295

WATER SUPPLY OF WORCESTER.

In the latter part of 1894, the Lynde Brook Reservoir becoming nearly exhausted, a temporary connection was made between this Reservoir and Kettle Brook, and water was drawn from the latter source for the supply of the city. Early in 1895 the city of

Worcester decided to make Kettle Brook a permanent addition to its water supply system, and laid a 30-inch cast iron pipe conduit from the Kent Reservoir, on Kettle Brook, to the Lynde Brook Reservoir.

Above Kent Reservoir, on Kettle Brook, are three other reservoirs, known as the Mann Reservoir, Bottomly Pond and the Arnold Reservoir. Analyses of water from the Lynde Brook and Holden storage reservoirs and from the reservoirs on Kettle Brook are given in the tables which follow.

The advice of the State Board of Health to the city of Worcester relative to the use of Kettle Brook as an additional source of water supply for the city may be found on pages 57 and 58 of this volume.

LEICESTER SUPPLY. — *Chemical Examination of Water from Lynde Brook Storage Reservoir.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13656	Jan. 14	Slight.	Slight.	.45	4.70	1.50	.0028	.0152	.0144	.0008	.25	.0250	.0000	.4961	1.9
13852	Feb. 19	None.	V slight.	.52	5.45	1.45	.0046	.0166	.0142	.0024	.29	.0300	.0000	.5889	1.7
14004	Mar. 19	V. slight.	Slight.	.38	3.25	0.95	.0030	.0134	.0116	.0018	.19	.0200	.0000	.4740	1.3
14141	Apr. 15	Distinct.	Slight.	.28	3.45	1.30	.0040	.0128	.0094	.0034	.19	.0200	.0001	.4187	1.1
14326	May 19	V. slight.	V. slight.	.25	3.30	1.30	.0014	.0134	.0122	.0012	.23	.0100	.0000	.4029	1.3
14486	June 18	Slight.	Slight.	.23	3.50	1.55	.0004	.0172	.0142	.0030	.18	.0070	.0000	.3627	0.6
14663	July 22	V. slight.	Slight.	.20	3.10	1.05	.0004	.0164	.0146	.0018	.18	.0000	.0000	.3825	-
14865	Aug. 19	V. slight.	V. slight.	.18	3.20	1.15	.0008	.0164	.0150	.0014	.20	.0000	.0000	.3510	1.3
15174	Sept. 16	V. slight.	Slight, green.	.20	3.70	1.40	.0002	.0150	.0134	.0016	.25	.0000	.0001	.3900	1.3
15366	Oct. 14	Decided, clayey.	Cons.	.30	3.55	1.15	.0096	.0230	.0178	.0052	.20	.0070	.0000	.5031	0.9
15564	Nov. 17	Slight.	Slight.	.33	3.05	1.50	.0086	.0168	.0132	.0036	.17	.0070	.0001	.5117	0.8
15745	Dec. 16	None.	Slight.	.47	3.30	1.35	.0044	.0174	.0162	.0012	.13	.0130	.0001	.5005	1.1
Av.	....	....	....	.32	3.63	1.30	.0033	.0161	.0138	.0023	.20	.0116	.0000	.4485	1.2

Averages by Years.

-	1887*	-	-	.30	3.15	0.95	.0057	.0194	-	-	.15	.0043	-	-	-
-	1888	-	-	.24	2.64	0.85	.0037	.0151	-	-	.14	.0065	.0001	-	-
-	1889	-	-	.24	2.54	0.60	.0030	.0167	.0138	.0029	.16	.0053	.0001	-	-
-	1890	-	-	.21	3.07	1.15	.0026	.0132	.0107	.0025	.14	.0078	.0001	-	0.9
-	1891	-	-	.24	2.83	1.03	.0045	.0126	.0101	.0025	.12	.0074	.0001	-	0.7
-	1892	-	-	.25	2.99	1.15	.0038	.0139	.0113	.0026	.15	.0105	.0000	-	0.8
-	1893	-	-	.26	2.66	0.98	.0036	.0162	.0122	.0039	.15	.0066	.0001	.3465	0.6
-	1894	-	-	.36	3.37	1.09	.0055	.0139	.0117	.0022	.18	.0103	.0000	.3522	1.2
-	1895	-	-	.32	3.63	1.30	.0033	.0161	.0138	.0023	.20	.0116	.0000	.4485	1.2

* June to December.

NOTE to analyses of 1895: Odor, generally faintly vegetable; in January, September, October and November, distinctly vegetable. On heating, the odor became stronger and also mouldy. —— The samples were collected from the reservoir near the gate-house, about 1 foot beneath the surface.

For record of heights of water in this reservoir, see page 356.

WORCESTER.

Microscopical Examination of Water from Lynde Brook Storage Reservoir.

[Number of organisms per cubic centimeter.]

	1893.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	20	16	21	19	24	20	17	17	21	18
Number of sample,	13656	13852	14004	14141	14326	14486	14663	14865	15174	15366	15564	15745
PLANTS.												
Diatomaceæ,	4	1	4	11	9	64	120	11	23	7	29	12
Asterionella,	0	0	0	0	9	0	11	0	0	0	19	8
Cyclotella,	1	0	0	8	0	60	0	7	20	1	0	0
Melosira,	0	0	0	0	0	0	0	1	0	5	6	0
Navicula,	0	0	1	2	0	0	1	2	0	1	0	0
Stephanodiscus,	0	0	0	0	0	0	108	0	0	0	0	0
Synedra,	2	1	3	1	0	4	0	1	0	0	4	0
Tabellaria,	1	0	0	0	0	0	0	0	3	0	0	4
Cyanophyceæ,	0	0	0	0	0	220	208	192	68	6	0	0
Chroöcoccus,	0	0	0	0	0	0	0	188	68	4	0	0
Merismopedia,	0	0	0	0	0	0	208	4	0	0	0	0
Microcystis,	0	0	0	0	0	220	0	0	0	2	0	0
Algæ,	0	0	0	0	155	11	1,125	251	48	57	0	0
Chlorococcus,	0	0	0	0	0	11	0	212	2	12	0	0
Protococcus,	0	0	0	0	150	0	1,120	29	42	45	0	0
Raphidium,	0	0	0	0	4	0	4	0	2	0	0	0
Scenedesmus,	0	0	0	0	1	0	1	4	0	0	0	0
Staurogenia,	0	0	0	0	0	0	0	6	2	0	0	0
Fungi, Crenothrix,	2	1	2	27	0	1	1	0	0	72	4	2
ANIMALS.												
Infusoria,	0	1	1	43	1	0	1	7	1	7	6	4
Dinobryon,	0	0	0	28	0	0	0	0	0	7	0	4
Dinobryon cases,	0	0	1	8	0	0	0	0	0	0	5	0
Peridinium,	0	0	0	7	1	0	0	0	0	0	1	0
Trachelomonas,	0	1	0	0	0	0	1	7	1	0	0	0
Vermes, Polyarthra,	0	0	0	1	1	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	0	0	0	50	0	0	92	0	400	2	0
TOTAL,	6	3	7	82	216	296	1,455	553	140	549	41	18

WORCESTER.

HOLDEN SUPPLY.— *Chemical Examination of Water from Tatnuck Brook Storage Reservoir.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13657	Jan. 14	Slight.	Slight, green.	.30	2.55	1.00	.0016	.0158	.0130	.0028	.20	.0050	.0000	.3555	0.8
13853	Feb. 19	V. slight.	V. slight.	.25	2.75	0.80	.0052	.0108	.0096	.0012	.20	.0130	.0000	.3120	0.6
14005	Mar. 19	V. slight.	V. slight.	.20	2.35	0.85	.0028	.0102	.0086	.0016	.20	.0050	.0000	.3176	0.8
14142	Apr. 15	Slight.	Slight.	.20	2.15	1.00	.0008	.0160	.0112	.0048	.17	.0030	.0001	.3120	0.5
14327	May 19	Distinct.	Cons.	.18	2.40	1.00	.0012	.0150	.0098	.0052	.18	.0000	.0000	.3120	0.5
14485	June 18	Distinct.	Slight.	.20	2.20	0.80	.0000	.0142	.0120	.0022	.16	.0200	.0000	.3058	0.3
14664	July 22	Slight.	Cons.	.18	1.85	1.00	.0010	.0196	.0154	.0042	.17	.0000	.0000	.3075	0.3
14866	Aug. 19	Distinct, green.	Slight.	.13	2.25	1.05	.0000	.0262	.0196	.0066	.22	.0000	.0000	.5616	0.3
15173	Sept. 16	Distinct.	Slight.	.15	2.80	1.25	.0000	.0198	.0110	.0088	.20	.0030	.0002	.3056	0.5
15367	Oct. 14	Distinct.	Cons.	.22	2.30	1.10	.0002	.0246	.0168	.0078	.19	.0050	.0000	.3783	0.5
15565	Nov. 17	Distinct.	Cons., green.	.23	2.25	1.15	.0004	.0192	.0162	.0030	.16	.0030	.0000	.4290	0.3
15746	Dec. 16	None.	V. slight.	.28	2.15	0.80	.0008	.0158	.0128	.0030	.14	.0250	.0000	.3965	0.3
Av.	....	....	....	.21	2.33	0.98	.0012	.0173	.0130	.0043	.18	.0068	.0000	.3578	0.5

Averages by Years.

-	1887*	-	-	.29	2.62	1.01	.0007	.0197	-	-	.14	.0016	-	-	-
-	1888	-	-	.17	2.23	0.75	.0012	.0157	-	-	.12	.0043	.0001	-	-
-	1889	-	-	.19	2.04	0.57	.0003	.0143	.0112	.0031	.12	.0031	.0001	-	-
-	1890	-	-	.17	2.68	1.24	.0007	.0141	.0102	.0039	.13	.0078	.0001	-	0.9
-	1891	-	-	.17	2.30	0.94	.0024	.0143	.0102	.0041	.11	.0077	.0001	-	0.4
-	1892	-	-	.20	2.52	1.03	.0012	.0142	.0113	.0029	.12	.0067	.0000	-	0.5
-	1893	-	-	.35	2.45	0.93	.0020	.0182	.0140	.0042	.14	.0049	.0000	.3594	0.5
-	1894	-	-	.20	2.27	0.85	.0010	.0151	.0114	.0037	.16	.0032	.0000	.2978	0.4
-	1895	-	-	.21	2.33	0.98	.0012	.0173	.0130	.0043	.18	.0068	.0000	.3578	0.5

* June to December.

NOTE to analyses of 1895: Odor, generally faintly vegetable, rarely unpleasant, frequently stronger on heating. In April, the odor was disagreeable on heating; in May, unpleasant and oily.—— The first sample was collected from the reservoir at the end of the 30-inch pipe through the dam; the second, at the outlet below the dam; and the others, from the reservoir at the gate-house, 1 foot beneath the surface.

For record of heights of water in this reservoir, see page 356.

WORCESTER.

HOLDEN SUPPLY. — *Microscopical Examination of Water from the Tatnuck Brook Storage Reservoir.*

[Number of organisms per cubic centimeter.]

	1895.											
	Jan.	Feb.	Mar	Apr.	May	June	July.	Aug	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	20	16	21	19	24	21	17	17	21	18
Number of sample,	13657	13853	14005	14142	14327	14485	14664	14866	15173	15367	15565	15746
PLANTS.												
Diatomaceæ,	**7**	**2**	**4**	**50**	**324**	**643**	**433**	**325**	**514**	**1,306**	**1,124**	**86**
Asterionella,	7	0	2	3	2	11	9	2	66	112	592	49
Cyclotella,	0	0	0	2	2	60	0	7	0	6	0	4
Fragilaria,	0	0	0	0	0	2	0	0	0	0	0	6
Melosira,	0	0	0	28	47	0	0	0	24	500	348	8
Synedra,	0	1	1	9	5	2	8	20	0	140	28	0
Tabellaria,	0	1	1	8	268	568	416	296	424	548	156	19
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**4**	**2**	**5**	**8**	**0**	**0**	**0**
Anabæna,	0	0	0	0	0	0	2	5	6	0	0	0
Microcystis,	0	0	0	0	0	4	0	0	2	0	0	0
Algæ,	**1**	**0**	**0**	**16**	**185**	**6**	**31**	**22**	**42**	**84**	**4**	**0**
Arthrodesmus,	0	0	0	0	1	2	1	4	0	1	0	0
Protococcus,	0	0	0	14	172	0	24	7	0	4	0	0
Raphidium,	0	0	0	0	0	1	2	5	2	10	3	0
Scenedesmus,	1	0	0	2	11	2	0	0	0	1	0	0
Staurastrum,	0	0	0	0	1	1	4	6	40	68	1	0
Fungi, Crenothrix,	**2**	**32**	**10**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
ANIMALS.												
Infusoria,	**4**	**8**	**38**	**686**	**68**	**0**	**254**	**138**	**10**	**54**	**3**	**15**
Ciliated infusorian,	0	0	0	1	2	0	0	0	0	0	0	0
Cryptomonas,	0	0	0	0	50	0	0	0	0	0	0	0
Dinobryon,	0	0	1	432	0	0	2	0	0	0	0	0
Dinobryon cases,	0	1	36	244	0	0	0	0	0	0	0	0
Euglena,	0	0	pr.	0	0	0	0	0	0	52	2	1
Monas,	0	0	0	0	0	0	1	0	0	0	0	3
Peridinium,	4	7	1	9	9	0	248	134	0	0	1	11
Synura,	0	0	0	0	2	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	0	2	0	3	4	10	2	0	0
Uroglena,	0	0	0	0	3	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	**11**	**0**	**0**	**112**	**132**	**0**	**0**	**20**	**12**	**0**	**40**	**5**
TOTAL,	25	42	52	865	712	653	720	510	586	1,444	1,173	106

WORCESTER.

Chemical Examination of Water from Kent Reservoir on Kettle Brook in Leicester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
15561	Nov. 17	Slight.	Slight.	.57	3.65	1.90	.0014	.0232	.0174	.0058	.17	.0080	.0001	.6669	0.8
15743	Dec. 16	V. slight.	V. slight.	.90	4.15	2.05	.0130	.0232	.0220	.0012	.13	.0150	.0001	.7969	0.8

Odor, distinctly vegetable, becoming also mouldy on heating. —— The samples were collected from the reservoir near the gate-house.

Microscopical Examination.

No. 15561. Diatomaceæ, *Asterionella*, 67; *Cyclotella*, 1; *Melosira*, 4; *Navicula*, 1; *Synedra*, 6; *Tabellaria*, 8. Algæ, *Arthrodesmus*, 1; *Closterium*, 1; *Staurogenia*, 4. Fungi, *Crenothrix*, 3. Infusoria, *Dinobryon*, 74; *Trachelomonas*, 1. Miscellaneous, *Zoöglœa*, 20. Total, 191.

No. 15743. Diatomaceæ, *Asterionella*, 12. Algæ, *Raphidium*, 3; *Zoöspores*, 1. Fungi, *Crenothrix*, 3. Total, 19.

Chemical Examination of Water from Mann Reservoir on Kettle Brook, Leicester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13825	Feb. 15	V. slight.	V. slight.	.40	4.15	1.30	.0130	.0114	.0106	.0008	.24	.0180	.0000	.4400	1.7
14552	June 28	Slight.	Cons.	.23	2.65	1.15	.0006	.0208	.0134	.0074	.18	.0000	.0000	.3927	0.9
14662	July 22	Slight.	Slight.	.40	3.20	1.35	.0000	.0202	.0174	.0028	.17	.0040	.0000	.4875	1.1
14864	Aug. 19	Distinct.	Cons., green.	.35	3.45	1.30	.0010	.0278	.0194	.0084	.16	.0000	.0000	.5226	0.9
15176	Sept. 16	Distinct.	Cons., yellow.	.30	4.05	1.80	.0054	.0306	.0218	.0088	.19	.0030	.0002	.4540	1.3
15365	Oct. 14	Decided.	Cons.	.75	3.85	2.25	.0000	.0278	.0218	.0060	.20	.0180	.0000	.9500	0.8
15563	Nov. 17	Slight.	Slight.	.60	3.30	2.10	.0066	.0240	.0220	.0020	.16	.0070	.0001	.7800	0.6
15744	Dec. 16	V. slight.	V. slight.	.95	3.85	2.10	.0168	.0248	.0232	.0016	.13	.0150	.0001	.8085	0.8
Av.	....	....	....	.50	3.56	1.67	.0054	.0234	.0187	.0047	.18	.0087	.0000	.6044	1.0

Odor, vegetable. —— The first sample was collected from the brook at the outlet of the reservoir and the others from the reservoir near the dam, 1 foot beneath the surface.

WORCESTER.

Microscopical Examination of Water from Mann Reservoir on Kettle Brook, Leicester.

[Number of organisms per cubic centimeter.]

	1895.							
	Feb.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	16	29	23	20	17	17	21	18
Number of sample,	13825	14552	14662	14864	15176	15365	15563	15744
PLANTS.								
Diatomaceæ,	**9**	**819**	**212**	**266**	**154**	**130**	**282**	**3**
Asterionella,	0	0	0	29	1	0	224	0
Cyclotella,	0	0	176	96	0	0	0	0
Diatoma,	0	5	0	0	2	4	0	0
Fragilaria,	0	0	0	0	0	12	13	0
Melosira,	8	800	33	138	144	68	24	0
Meridion,	0	1	0	0	0	6	0	0
Navicula,	pr.	7	1	1	2	8	1	0
Pinnularia,	0	1	1	0	2	2	0	0
Surirella,	0	0	0	0	1	6	0	0
Synedra,	1	3	1	2	2	24	7	0
Tabellaria,	pr.	2	0	0	0	0	13	3
Cyanophyceæ, Anabæna,	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**
Algæ,	**pr.**	**44**	**13**	**358**	**30**	**20**	**2**	**5**
Arthrodesmus,	0	0	0	4	0	0	0	0
Chlorococcus,	0	0	0	340	2	0	0	0
Cosmarium,	0	0	0	0	3	0	1	0
Glœocapsa,	0	2	0	3	0	0	0	0
Pediastrum,	0	5	0	0	0	0	0	0
Protococcus,	0	24	11	0	14	10	0	0
Raphidium,	0	11	0	1	7	2	1	5
Scenedesmus,	pr.	0	0	8	3	4	0	0
Staurastrum,	0	2	2	2	1	0	0	0
Staurogenia,	0	0	0	0	0	4	0	0
Fungi, Crenothrix,	**0**	**2**	**0**	**5**	**0**	**200**	**10**	**0**
ANIMALS.								
Infusoria,	**0**	**2**	**195**	**19**	**615**	**6**	**18**	**6**
Codonella,	0	0	0	0	1	0	2	0
Dinobryon,	0	0	35	6	460	0	16	5
Dinobryon cases,	0	0	0	0	152	0	0	0
Mallomonas,	0	2	0	1	1	0	0	0
Peridinium,	0	0	160	12	0	0	0	1
Tintinnidium,	0	0	0	0	1	0	0	0
Trachelomonas,	0	0	0	0	0	6	0	0
Vermes,	**0**	**1**	**0**	**0**	**2**	**2**	**0**	**0**
Anurea,	0	1	0	0	0	0	0	0
Nais,	0	0	0	0	0	2	0	0
Rotatorian ova,	0	0	0	0	2	0	0	0
Miscellaneous, Zoöglœa,	**0**	**0**	**0**	**0**	**0**	**0**	**40**	**0**
TOTAL,	9	868	420	648	801	364	352	14

WORCESTER.

Chemical Examination of Water from Bottomly Pond, Paxton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
14551	June 28	V. slight.	Slight.	0.25	2.75	1.50	.0002	.0166	.0130	.0036	.19	.0030	.0000	.4774	0.8
14661	July 22	Slight.	Cons.	0.30	3.00	1.60	.0006	.0208	.0202	.0006	.16	.0000	.0000	.5175	1.1
14863	Aug. 19	Slight.	Slight.	0.20	3.15	1.40	.0002	.0216	.0202	.0014	.16	.0000	.0000	.5928	0.8
15175	Sept. 16	Slight.	Slight, green.	0.30	4.00	1.85	.0004	.0252	.0214	.0038	.20	.0030	.0002	.5320	0.9
15364	Oct. 14	Slight.	Cons.	0.35	3.40	1.65	.0000	.0264	.0218	.0046	.20	.0070	.0000	.5772	1.1
15560	Nov. 17	Slight.	Slight.	0.70	3.55	2.25	.0158	.0286	.0260	.0026	.14	.0050	.0001	.8073	1.1
15742	Dec. 16	V. slight.	Cons.	1.10	4.75	2.75	.0220	.0422	.0334	.0088	.14	.0220	.0004	.9563	1.3
Av.	....	....	....	0.46	3.51	1.84	.0056	.0259	.0223	.0036	.17	.0057	.0001	.6372	1.0

Odor, distinctly vegetable, except in December, when it was faintly oily, becoming stronger on heating. —— The samples were collected from the pond near the dam, 1 foot beneath the surface.

Microscopical Examination of Water from Bottomly Pond, Paxton.

[Number of organisms per cubic centimeter.]

	1895.						
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	29	23	20	17	17	21	18
Number of sample,	14551	14661	14863	15175	15364	15560	15742
PLANTS.							
Diatomaceæ,	**28**	**19**	**352**	**272**	**44**	**99**	**32**
Asterionella,	0	0	184	24	23	96	10
Cyclotella,	3	12	168	248	16	0	18
Melosira,	25	0	0	0	0	0	0
Navicula,	0	2	0	0	0	2	0
Synedra,	0	3	0	0	2	1	0
Tabellaria,	0	2	0	0	3	0	4
Cyanophyceæ,	**0**	**23**	**9**	**8**	**8**	**0**	**0**
Anabæna,	0	0	0	8	0	0	0
Anabæna spores,	0	5	0	0	0	0	0
Chroöcoccus,	0	0	9	0	0	0	0
Merismopedia,	0	18	0	0	8	0	0
Algæ,	**116**	**34**	**54**	**58**	**42**	**31**	**5**
Chlorococcus,	0	0	40	0	0	1	0
Cosmarium,	1	0	2	0	1	0	0
Protococcus,	115	31	1	0	0	0	0
Raphidium,	0	0	6	56	35	0	5
Scenedesmus,	0	0	4	0	0	0	0
Staurastrum,	0	2	0	1	0	1	0
Staurogenia,	0	1	1	0	6	25	0
Zoöspores,	0	0	0	1	0	4	0
Fungi, Crenothrix,	**0**	**6**	**0**	**0**	**0**	**0**	**1**

WORCESTER.

Microscopical Examination of Water from Bottomly Pond, Paxton — Concluded.

[Number of organisms per cubic centimeter.]

	1895.						
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.							
Infusoria,	4	1	1	7	4	17	41
Codonella,	0	0	0	0	0	3	0
Dinobryon,	0	0	0	0	0	0	14
Dinobryon cases,	0	0	0	7	0	2	0
Mallomonas,	1	0	0	0	0	0	0
Monas,	0	0	1	0	0	0	0
Peridinium,	3	0	0	0	1	1	2
Trachelomonas,	0	1	0	0	3	0	0
Uroglena,	0	0	0	0	0	11	25
Vermes, Anurea,	0	0	0	0	0	1	0
Miscellaneous, Zoöglœa,	0	0	0	0	60	8	20
TOTAL,	148	83	416	345	158	156	99

Chemical Examination of Water from Arnold Reservoir on Kettle Brook, Paxton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14550	June 28	Distinct.	Cons.	1.60	5.50	3.50	.0016	.0412	.0324	.0088	.22	.0070	.0000	1.9250	1.3
14660	July 22	Slight.	Cons.	1.90	5.75	3.65	.0092	.0570	.0548	.0022	.23	.0020	.0002	1.6500	1.8
14862	Aug. 19	Distinct, green.	Slight, green.	2.00	3.45	2.10	.0060	.0588	.0500	.0088	.20	.0090	.0001	1.7160	1.3
15177	Sept. 16	Slight.	Cons.	1.80	6.20	3.60	.0112	.0570	.0494	.0076	.28	.0030	.0003	1.6263	1.6
15363	Oct. 14	Slight.	Slight.	1.70	4.90	3.00	.0366	.0504	.0488	.0016	.24	.0100	.0001	1.5444	0.9
15562	Nov. 17	Slight.	Slight.	1.90	4.85	3.15	.0395	.0396	.0360	.0036	.20	.0070	.0002	1.3923	0.8
Av.	....	....	....	1.82	5.11	3.17	.0173	.0506	.0452	.0054	.23	.0048	.0001	1.6423	1.3

Odor, distinctly vegetable. —— The samples were collected from the reservoir near the dam, 1 foot beneath the surface.

WORCESTER.

Microscopical Examination of Water from Arnold Reservoir on Kettle Brook, Paxton.

[Number of organisms per cubic centimeter.]

	1895					
	June.	July.	Aug.	Sept.	Oct.	Nov.
Day of examination,	29	23	20	17	17	21
Number of sample,	14550	14660	14862	15177	15363	15562
PLANTS.						
Diatomaceæ,	28	26	57	28	4	16
Asterionella,	0	0	0	2	0	4
Cyclotella,	0	20	28	0	0	4
Diatoma,	0	0	0	5	0	0
Navicula,	0	0	1	3	1	0
Surirella,	0	0	0	3	0	0
Synedra,	28	0	28	14	3	6
Tabellaria,	0	6	0	1	0	2
Cyanophyceæ,	0	32	46	0	0	0
Chroöcoccus,	0	0	6	0	0	0
Microcystis,	0	0	40	0	0	0
Oscillaria,	0	32	0	0	0	0
Algæ,	662	61	1,601	135	40	0
Arthrodesmus,	0	0	3	0	0	0
Chlorococcus,	0	0	140	0	0	0
Cosmarium,	1	0	0	0	0	0
Eudorina,	0	0	3	0	0	0
Glœocapsa,	40	1	48	2	0	0
Pandorina,	0	0	11	0	0	0
Protococcus,	620	24	1,356	76	35	0
Raphidium,	1	0	20	24	0	0
Scenedesmus,	0	0	14	5	1	0
Staurastrum,	0	36	6	2	0	0
Staurogenia,	0	0	0	26	4	0
Fungi, Crenothrix,	40	56	13	4	24	4
ANIMALS.						
Infusoria,	0	0	688	18	2	2
Dinobryon,	0	0	344	13	0	0
Dinobryon cases,	0	0	216	0	0	0
Peridinium,	0	0	44	2	1	2
Phacus,	0	0	0	1	1	0
Trachelomonas,	0	0	84	1	0	0
Vorticella.	0	0	0	1	0	0
Vermes,	0	0	11	6	1	0
Anuræa,	0	0	0	1	1	0
Polyarthra,	0	0	4	0	0	0
Rotatorian ova,	0	0	6	5	0	0
Rotifer,	0	0	1	0	0	0
Crustacea, Daphnia,	.02	.02	0	0	0	0
Miscellaneous, Zoöglœa,	0	0	40	4	3	12
TOTAL,	730	175	2,456	195	74	34

WORCESTER.

Record of Height of Water in Leicester and Holden Storage Reservoirs on the First of Each Month in 1895.

NOTE — Leicester Reservoir, height of rollway, 37.40 feet; Holden Reservoir, height of rollway, 30.10 feet.

Date.	Height of Water. Leicester.	Height of Water. Holden.
1895.	Feet.	Feet.
Jan. 1,	12.10	18.30
Feb. 1,	21.87	21.65
March 1,	20.90	20.78
April 1,	27.05	27.30
May 1,	33.55	30.98
June 1,	33.30	30.94

Date.	Height of Water. Leicester.	Height of Water. Holden.
1895.	Feet.	Feet.
July 1,	32.10	30.33
Aug. 1,	30.80	29.25
Sept. 1,	28.88	27.40
Oct. 1,	25.87	25.25
Nov. 1,	30.00	30.00
Dec. 1,	35.35	30.25

WRENTHAM.

The advice of the State Board of Health to G. H. Bacon and others of the village of Plainville, in the town of Wrentham, relative to taking the water of the Ten Mile River as a source of public water supply for the village, may be found on page 58 of this volume.

The advice of the State Board of Health to the town of North Attleborough relative to taking water from Ten Mile River for a supply of the town of North Attleborough and the village of Plainville may be found on page 35 of the annual report for 1894, and analyses of water from this source may be found on page 268 of the same volume.

EXAMINATION OF RIVERS.

EXAMINATION OF RIVERS.

Regular monthly examinations have been made during the year 1895 of the waters of the Blackstone, Deerfield, Hoosac, Housatonic, Merrimack, Nashua, Neponset, Saugus, Taunton and Ware rivers, and occasional examinations of other rivers in the State. A special examination of the Blackstone River, similar to that made in 1891, was made during the week of September 4–11. A special examination of the Neponset River was made in the drier portion of the year, in connection with investigations of the sanitary condition of the river and the Fowl Meadows, made under direction of chapter 83 of the Resolves of 1895. Examinations were also made of the Charles River at Milford and a small tidal stream known as Crane's River at Danvers, in consequence of complaints as to their sanitary condition.

Most of the results of these examinations will be found arranged alphabetically by rivers in the following pages, but some of them are given on preceding pages, in connection with the examination of water supplies, under the names of towns where the samples were collected, as follows: —

Blackstone River.

The regular monthly examinations of the Blackstone River have been continued since June, 1887, and the average results for each calendar year and for the six months of each year from June to

BLACKSTONE RIVER.

November, as well as the detailed analyses for 1895, are given in the tables which follow.

During the year ending Nov. 30, 1895, an average of 15,700,000 gallons per day of mingled sewage and brook water, taken from the Mill Brook channel, were treated at the Worcester Precipitation Works, by the addition of about 1,030 pounds of lime per 1,000,000 gallons of sewage, the effluent and the excess of the flow of Mill Brook over the amount treated being discharged into the river. The first of the following tables is taken from the report of the superintendent of sewers of the city of Worcester for the year ending Nov. 30, 1895, and contains the monthly averages of analyses of sewage and effluent and the per cent. removed by treatment.

The special examination of the river was, as nearly as practicable, a repetition of the examination made in July, 1891, and, like that examination, was made at a time of low flow in the stream, in order that the results of the examinations might be comparable. The advice of the State Board of Health to the town of Millbury, relative to the pollution of the Blackstone River by the sewage and sewage effluent from the city of Worcester, may be found on pages 67–69 of this volume.

WORCESTER SEWAGE PURIFICATION WORKS.

Abstract of Analyses of Sewage and Effluent.

[Taken from the annual report of the superintendent of sewers of the city of Worcester for the year ending Nov. 30, 1895.]

[Parts per 100,000.]

DATE OF COLLECTION.	Ammonia.				Oxygen Consumed.		
		Albuminoid.					
	Free.	Total.	Dissolved.	Suspended.	Unfiltered.	Filtered.	Chlorine.
Sewage, December, 1894,	1.400	.550	.278	.272	5.38	3.16	6.30
Effluent, December, 1894,	1.292	.273	.240	.033	3.02	2.83	6.29
Parts removed,	.108	.277	.038	.239	2.36	0.33	0.01
Per cent. removed,	7.71	50.36	13.68	87.94	43.86	10.44	0.16
Sewage, January, 1895,	1.186	.471	.254	.217	5.23	3.21	6.38
Effluent, January, 1895,	1.001	.250	.229	.021	2.85	2.65	6.28
Parts removed,	.185	.221	.025	.196	2.38	0.56	0.10
Per cent. removed,	15.60	46.92	9.84	90.33	45.51	17.45	1.57
Sewage, February, 1895,	1.378	.615	.310	.305	5.60	3.46	7.27
Effluent, February, 1895,	1.158	.296	.274	.022	3.11	2.91	7.27
Parts removed,	.220	.319	.036	.283	2.49	0.55	0.00
Per cent. removed,	15.96	51.87	11.61	92.79	44.46	15.90	0.00

BLACKSTONE RIVER.

WORCESTER SEWAGE PURIFICATION WORKS — *Concluded.*

[Parts per 100,000.]

DATE OF COLLECTION.	AMMONIA.				OXYGEN CONSUMED.		
		ALBUMINOID.					
	Free.	Total.	Dissolved.	Suspended.	Unfiltered.	Filtered.	Chlorine.
Sewage, March, 1895,	.731	.353	.178	.175	3.76	2.20	4.35
Effluent, March, 1895,	.644	.182	.169	.013	1.89	1.77	4.37
Parts removed,	.087	.171	.009	.162	1.87	0.43	—0.02
Per cent. removed,	11.91	48.44	5.05	92.58	49.73	19.54	—0.46
Sewage, April, 1895,	.730	.332	.173	.159	3.70	2.23	4.32
Effluent, April, 1895,	.630	.185	.172	.013	1.98	1.81	4.30
Parts removed,	.100	.147	.001	.146	1.72	0.42	0.02
Per cent. removed,	13.70	44.28	.58	89.74	46.48	18.83	0.46
Sewage, May, 1895,	1.218	.603	.256	.347	5.59	3.16	6.36
Effluent, May, 1895,	1.071	.285	.265	.020	2.68	2.48	6.34
Parts removed,	.147	.318	—0.009	.327	2.91	0.68	0.02
Per cent. removed,	12.07	52.73	—3.52	94.23	50.27	21.52	0.31
Sewage, June, 1895,	1.346	.607	.262	.345	6.04	2.70	6.61
Effluent, June, 1895,	1.223	.291	.261	.030	2.42	2.20	6.66
Parts removed,	.123	.316	.001	.315	3.62	0.50	—0.05
Per cent. removed,	9.14	52.06	0.38	91.31	59.94	18.52	—0.76
Sewage, July, 1895,	1.432	.604	.285	.319	7.10	3.25	6.90
Effluent, July, 1895,	1.210	.272	.239	.033	2.57	2.44	6.73
Parts removed,	.222	.332	.046	.286	4.53	0.81	0.17
Per cent. removed,	15.51	54.96	16.14	89.66	63.80	24.92	2.46
Sewage, August, 1895,	1.240	.575	.267	.308	5.96	3.28	6.50
Effluent, August, 1895,	1.069	.272	.245	.027	2.18	2.18	6.26
Parts removed,	.171	.303	.022	.281	3.78	1.10	0.24
Per cent. removed,	10.56	52.69	8.24	91.22	63.43	33.54	3.69
Sewage, September, 1895,	1.500	.718	.333	.385	6.23	3.28	7.09
Effluent, September, 1895,	1.270	.300	.280	.020	2.25	2.25	6.77
Parts removed,	.230	.418	.053	.365	3.98	1.03	0.32
Per cent. removed,	15.33	58.22	15.92	94.79	63.72	31.39	4.51
Sewage, October, 1895,	1.165	.487	.222	.265	5.00	2.88	5.80
Effluent, October, 1895,	.968	.246	.209	.037	2.13	2.02	5.82
Parts removed,	.197	.241	.013	.228	2.87	0.86	—0.02
Per cent. removed,	16.90	49.49	5.86	86.04	57.40	29.86	—0.34
Sewage, November, 1895,	.590	.306	.166	.140	3.59	2.11	3.87
Effluent, November, 1895,	.564	.171	.154	.017	1.75	1.67	3.90
Parts removed,	.026	.135	.012	.123	1.84	0.44	—0.03
Per cent. removed,	4.41	44.12	7.23	87.86	51.25	20.85	—0.77
Sewage for year ending Dec. 1, 1895,	1.160	.518	.249	.270	5.27	2.91	5.98
Effluent for year ending Dec. 1, 1895,	1.008	.252	.228	.024	2.40	2.27	5.92
Parts removed,	.151	.2665	.021	.246	2.86	0.64	0.063
Per cent. removed,	13.02	51.63	8.43	91.11	54.35	21.99	1.05

NOTE. — Monthly averages are made from daily analyses of sewage and effluent. The daily sewage samples consist of forty-eight portions taken half hourly. Sewage samples are taken as nearly as possible in proportion to the amount of sewage being received at the time of sampling. Effluent samples consist of twenty-four portions taken hourly.

BLACKSTONE RIVER.

AVERAGES OF CHEMICAL ANALYSES OF WATER FROM THE BLACKSTONE RIVER FOR THE YEARS 1888 TO 1895, INCLUSIVE.

Blackstone River between Mill Brook Channel and the Sewage Precipitation Works.

[Parts per 100,000.]

YEAR.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
1888,	0.64	-	-	.2112	.1040	-	-	1.21	.0370	.0029	-
1889,	0.76	-	-	.2841	.1198	.0629	.0569	1.06	.0235	.0024	-
1890,	0.82	-	-	.1800	.1024	.0549	.0475	1.03	.0367	.0014	-
1891,	0.80	13.54	4.00	.3340	.1563	.0840	.0723	1.73	.0333	.0032	4.6
1892,	0.71	16.28	4.85	.2530	.1262	.0627	.0635	1.84	.0312	.0061	4.9
1893,	0.68	17.95	4.88	.1429	.0603	.0325	.0277	1.04	.0180	.0012	4.5
1894,	0.86	17.17	5.58	.0739	.0570	.0304	.0266	0.88	.0195	.0006	3.7
1895,	0.84	13.40	4.02	.0507	.0374	.0229	.0145	0.86	.0175	.0007	2.9

Blackstone River below Sewage Precipitation Works.

YEAR.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
1888,	0.64	-	-	.2112	.1040	-	-	1.21	.0370	.0029	-
1889,	0.76	-	-	.2841	.1198	.0629	.0569	1.06	.0235	.0024	-
1890,	0.74	-	-	.2253	.1177	.0581	.0596	1.26	.0381	.0016	-
1891,	0.80	15.62	4.52	.4080	.1303	.0695	.0608	1.91	.0358	.0031	4.6
1892,	0.53	19.35	5.29	.3633	.1442	.0737	.0705	2.21	.0278	.0033	7.2
1893,	0.74	25.65	6.54	.3757	.1447	.0864	.0583	1.98	.0369	.0070	7.4
1894,	0.60	25.75	6.61	.4228	.1309	.0946	.0363	2.13	.0316	.0047	7.9
1895,	0.79	19.14	4.78	.2298	.0840	.0573	.0267	1.52	.0347	.0040	5.8

Blackstone River at Uxbridge.

YEAR.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
1888,	0.45	-	-	.0979	.0284	-	-	0.61	.0322	.0008	-
1889,	0.28	-	-	.0992	.0300	.0191	.0109	0.60	.0253	.0009	-
1890,	0.25	-	-	.1168	.0214	.0152	.0062	0.66	.0272	.0006	-
1891,	0.27	8.32	1.94	.1647	.0272	.0197	.0075	0.77	.0396	.0008	2.8
1892,	0.21	8.59	1.90	.2113	.0222	.0153	.0069	0.82	.0326	.0007	2.8
1893,	0.40	9.45	1.91	.1603	.0256	.0167	.0089	1.00	.0424	.0029	3.2
1894,	0.51	10.80	1.97	.1372	.0242	.0187	.0055	1.22	.0460	.0032	4.0
1895,	0.64	10.56	2.44	.1081	.0315	.0243	.0072	1.05	.0439	.0037	3.9

Blackstone River at Millville.

YEAR.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
1888,	0.47	-	-	.0444	.0253	-	-	0.44	.0242	.0005	-
1889,	0.38	-	-	.0450	.0277	.0206	.0071	0.43	.0160	.0004	-
1890,	0.34	-	-	.0587	.0211	.0162	.0049	0.46	.0240	.0004	-
1891,	0.32	6.05	1.83	.0807	.0293	.0194	.0099	0.55	.0275	.0005	1.9
1892,	0.35	6.03	1.62	.0896	.0249	.0180	.0069	0.54	.0218	.0004	1.8
1893,	0.40	6.23	1.53	.0899	.0288	.0225	.0063	0.66	.0289	.0008	2.0
1894,	0.49	6.37	1.90	.0528	.0219	.0173	.0046	0.73	.0232	.0008	2.5
1895,	0.58	7.47	2.27	.0501	.0253	.0189	.0064	0.74	.0278	.0016	2.7

BLACKSTONE RIVER.

AVERAGES OF CHEMICAL ANALYSES OF WATER FROM THE BLACKSTONE RIVER FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE, OF EACH YEAR FROM 1887 TO 1895.

Blackstone River between Mill Brook Channel and the Sewage Precipitation Works.

[Parts per 100,000.]

MONTHS.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
June-Nov., 1887,	0.91	-	-	.2686	.1741	-	-	1.35	.0160	-	-
" " 1888,	0.76	-	-	.2658	.1112	.0557	.0555	1.50	.0382	.0041	-
" " 1889,	0.86	-	-	.3980	.1430	.0772	.0658	1.32	.0177	.0026	-
" " 1890,	1.14	9.92	3.03	.2107	.1246	.0673	.0573	1.07	.0250	.0015	2.9
" " 1891,	1.10	17.42	5.59	.4913	.1950	.1127	.0823	2.29	.0192	.0037	5.0
" " 1892,	0.52	20.75	6.30	.3547	.1433	.0708	.0725	2.43	.0227	.0108	6.1
" " 1893,	0.40	16.98	4.55	.1480	.0588	.0240	.0348	1.01	.0115	.0015	6.3
" " 1894,	0.66	16.93	4.76	.0548	.0380	.0236	.0144	0.74	.0115	.0005	4.4
" " 1895,	0.49	14.17	4.50	.0613	.0414	.0243	.0171	0.92	.0163	.0006	3.4
Blackstone River below Sewage Precipitation Works.											
June-Nov., 1887,	0.91	-	-	.2686	.1741	-	-	1.35	.0160	-	-
" " 1888,	0.76	-	-	.2658	.1112	.0557	.0555	1.50	.0382	.0041	-
" " 1889,	0.86	-	-	.3980	.1430	.0772	.0658	1.32	.0177	.0026	-
" " 1890,	0.97	11.36	3.10	.2907	.1492	.0722	.0770	1.46	.0270	.0018	3.9
" " 1891,	1.05	22.25	6.60	.6367	.1508	.0883	.0625	2.61	.0233	.0040	6.2
" " 1892,	0.63	26.80	7.75	.5240	.1810	.0958	.0852	3.13	.0137	.0050	10.3
" " 1893,	0.51	30.00	7.13	.5680	.1453	.0900	.0553	2.76	.0285	.0126	10.9
" " 1894,	0.40	29.30	5.86	.6189	.1390	.1113	.0277	2.63	.0212	.0071	10.6
" " 1895,	0.71	22.15	5.18	.3246	.0898	.0597	.0301	1.86	.0267	.0063	7.3
Blackstone River at Uxbridge.											
June-Nov., 1887,	0.39	-	-	.1129	.0271	-	-	0.79	.0360	-	-
" " 1888,	0.38	6.42	1.52	.1155	.0288	.0222	.0066	0.68	.0310	.0007	-
" " 1889,	0.32	-	-	.1133	.0296	.0192	.0104	0.66	.0333	.0009	-
" " 1890,	0.26	8.86	2.12	.1629	.0231	.0174	.0057	0.79	.0259	.0005	2.9
" " 1891,	0.20	10.16	2.61	.2280	.0175	.0117	.0058	1.04	.0425	.0007	3.6
" " 1892,	0.13	9.36	1.88	.2840	.0227	.0162	.0065	0.99	.0313	.0007	3.1
" " 1893,	0.24	11.74	2.37	.1985	.0207	.0140	.0067	1.20	.0623	.0050	4.2
" " 1894,	0.35	13.07	2.03	.1456	.0243	.0183	.0060	1.57	.0673	.0050	4.9
" " 1895,*	0.56	12.95	2.69	.0906	.0258	.0182	.0076	1.34	.0631	.0065	4.7
Blackstone River at Millville.											
June-Nov., 1887,	0.31	-	-	.0468	.0220	-	-	0.51	.0210	-	-
" " 1888,	0.41	5.22	1.40	.0467	.0296	.0233	.0063	0.50	.0278	.0004	-
" " 1889,	0.38	-	-	.0499	.0273	.0213	.0060	0.45	.0167	.0003	-
" " 1890,	0.26	6.71	2.24	.0736	.0196	.0152	.0044	0.53	.0229	.0003	2.3
" " 1891,	0.24	7.48	2.35	.1105	.0384	.0234	.0150	0.72	.0308	.0006	2.2
" " 1892,	0.37	6.70	1.62	.1143	.0294	.0210	.0084	0.63	.0217	.0002	2.0
" " 1893,	0.23	7.43	1.73	.0677	.0119	.0087	.0031	0.77	.0385	.0011	2.6
" " 1894,	0.47	8.42	2.16	.0510	.0172	.0139	.0033	0.89	.0273	.0012	2.8
" " 1895,	0.51	8.67	2.55	.0356	.0233	.0180	.0053	0.90	.0383	.0024	3.2

* Average of five months. No sample was obtained in June.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River between

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1895.									
1	13671	Jan. 15	Distinct, milky.	Cons., dark.	1.40	9.60	8.20	1.40	3.20	1.80	1.40
2	13870	Feb. 20	Decided.	Heavy, brown.	0.48	24.00	16.20	7.80	7.40	4.20	3.20
3	14006	Mar. 19	Decided.	Cons.	1.50	12.80	10.00	2.80	2.40	1.80	0.60
4	14157	Apr. 16	Distinct.	Cons.	1.30	9.00	4.80	4.20	2.40	2.20	0.20
5	14343	May 21	Decided.	Cons., rusty.	1.30	11.20	7.60	3.60	2.60	2.40	0.20
6	14500	June 19	Decided, milky.	Heavy, rusty.	0.18	14.00	9.60	4.40	4.80	3.80	1.00
7	14686	July 23	Decided.	Heavy, rusty.	0.10	15.40	10.40	5.00	4.00	1.70	2.30
8	14878	Aug. 20	Distinct, milky.	Heavy, rusty.	0.08	15.20	9.60	5.60	5.40	3.40	2.00
9	15190	Sept. 17	Distinct, rusty.	Heavy, rusty.	0.08	17.60	14.80	2.80	3.80	2.60	1.20
10	15376	Oct. 15	Decided.	Cons.	1.25	11.20	9.60	1.60	4.40	4.00	0.40
11	15572	Nov. 19	Decided.	Cons.	1.25	11.60	9.80	1.80	4.60	3.40	1.20
12	15757	Dec. 17	Distinct, milky.	Slight, earthy.	1.20	9.20	7.40	1.80	3.20	2.80	0.40
13	Av.	....	....	....	0.84	13.40	9.83	3.57	4.02	2.84	1.18

Odor, disagreeable or offensive.—— The samples were collected from the river, about 200 feet below the iron bridge. Nos. 13870 and 14686 were collected on Wednesday, and the other samples on Tuesday. The samples were collected at various hours between 8.10 A.M. and 1.30 P.M.

Chemical Examination of Water from Blackstone

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1895.									
1	13672	Jan. 15	Distinct, milky.	Cons., dark.	1.20	15.00	13.00	2.00	2.80	2.40	0.40
2	13871	Feb. 20	Decided.	Heavy, brown.	1.00	21.40	14.60	6.80	3.80	3.40	0.40
3	14007	Mar. 19	Decided.	Heavy, dark.	0.25	18.40	11.40	7.00	5.60	2.40	3.20
4	14158	Apr. 16	Distinct.	Cons.	1.00	9.60	6.60	3.00	3.80	2.60	1.20
5	14344	May 21	Decided.	Heavy, rusty.	0.90	17.00	12.80	4.20	5.60	4.60	1.00
6	14501	June 19	Distinct, milky.	Heavy, brown.	0.22	24.40	18.00	6.40	6.40	3.60	2.80
7	14687	July 23	Decided.	Cous., brown.	0.66	24.40	21.40	3.00	4.50	3.70	0.80
8	14879	Aug. 20	Decided, rusty.	Heavy, rusty.	0.40	19.50	16.50	3.00	5.40	4.10	1.30
9	15191	Sept. 17	Decided, rusty.	Heavy, rusty.	0.20	38.00	35.40	2.60	6.60	6.20	0.40
10	15377	Oct. 15	Decided.	Cons.	1.50	15.00	12.60	2.40	4.60	3.40	1.20
11	15573	Nov. 19	Decided.	Cons.	1.25	11.60	9.60	2.00	3.60	2.20	1.40
12	15758	Dec. 17	Distinct, milky.	Cons., brown.	0.90	15.40	13.20	2.20	4.60	4.20	0.40
13	Av.	....	....	....	0.79	19.14	15.42	3.72	4.78	3.57	1.21

Odor, disagreeable, generally offensive.—— The samples were collected from the river, above Millbury and below the point where the effluent from the Worcester Sewage Precipitation Works enters the river. Nos. 13871 and 14687 were collected on Wednesday, and the remaining samples on Tuesday. The samples were collected at various hours between 8.20 A.M. and 1.40 P.M.

BLACKSTONE RIVER.

Mill Brook Channel and the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Iron.			
	Albuminoid.									
Free.	Total.	Dis-solved.	Sus-pended	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Hardness.	
.0192	.0284	.0240	.0044	1.00	.0200	.0005	0.3000	0.2200	1.9	1
.0320	.0350	.0140	.0210	0.81	.0000	.0020	1.6800	1.1600	–	2
.0960	.0430	.0300	.0130	0.78	.0230	.0010	0.8200	0.6400	3.5	3
.0508	.0400	.0252	.0148	0.76	.0370	.0007	0.5760	0.4300	2.3	4
.0112	.0320	.0208	.0112	0.52	.0070	.0002	0.4500	0.2000	1.7	5
.0316	.0488	.0172	.0316	0.59	.0080	.0006	1.2200	0.0940	2.6	6
.0720	.0380	.0170	.0210	0.77	.0030	.0001	0.9400	0.0280	3.6	7
.0368	.0304	.0172	.0132	1.16	.0070	.0004	0.9000	0.1200	2.7	8
.0960	.0230	.0190	.0040	1.02	.0100	.0004	1.5800	1.5000	7.0	9
.0464	.0492	.0416	.0076	0.76	.0400	.0012	0.3100	0.2400	2.3	10
.0850	.0590	.0340	.0250	1.22	.0300	.0011	0.2500	0.2200	2.3	11
.0320	.0220	.0150	.0070	0.89	.0250	.0005	0.4900	0.3640	1.7	12
.0507	.0374	.0229	.0145	0.86	.0175	.0007	0.7930	0.4346	2.9	13

Microscopical Examination.

Not examined.

River below the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Iron.			
	Albuminoid.									
Free.	Total.	Dis-solved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Hardness.	
.1560	.0510	.0450	.0060	1.36	.0450	.0017	0.2400	.1500	4.4	1
.1536	.0708	.0464	.0244	1.40	.0220	.0008	0.7600	.2160	–	2
.1360	.1750	.1130	.0620	1.17	.0420	.0015	0.9400	.0600	3.5	3
.0448	.0364	.0264	.0100	0.59	.0480	.0010	0.2500	.1640	2.6	4
.1680	.0870	.0620	.0250	1.08	.0300	.0025	0.3400	.1080	5.0	5
.3600	.0940	.0480	.0460	1.90	.0150	.0200	0.9000	.0440	7.6	6
.4560	.1020	.0620	.0400	2.06	.0050	.0000	–	.0900	9.3	7
.1760	.0910	.0600	.0310	1.59	.0220	.0040	0.9800	.1400	5.4	8
.7680	.1290	.1040	.0250	3.40	.0100	.0105	1.6400	.5700	15.2	9
.1036	.0676	.0472	.0204	1.13	.0680	.0018	0.5900	.2700	3.8	10
.0840	.0550	.0370	.0180	1.11	.0400	.0013	0.3900	.1300	2.5	11
.1520	.0490	.0360	.0130	1.43	.0700	.0025	0.3200	.1800	4.9	12
.2298	.0840	.0573	.0267	1.52	.0347	.0040	0.6682	.1768	5.8	13

Microscopical Examination.

Not examined.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River at Uxbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13690	Jan. 18	Distinct, milky.	Slight.	0.63	8.90	2.50	.1400	.0390	.0370	.0020	0.93	.0270	.0012	.5411	3.1
13874	Feb. 21	Decided.	Cons.	0.60	12.10	1.60	.2440	.0450	.0430	.0020	1.29	.0180	.0007	.4836	4.6
14029	Mar. 21	Distinct.	Slight.	0.75	6.90	1.70	.1040	.0370	.0270	.0100	0.61	.0200	.0014	.5214	2.7
14173	Apr. 17	Decided.	Heavy, earthy.	0.60	5.90	2.00	.0360	.0340	.0194	.0146	0.46	.0280	.0007	.5056	1.6
14357	May 23	Decided.	Cons., rusty.	0.75	7.90	2.40	.0920	.0220	.0160	.0060	0.80	.0270	.0025	.4446	3.5
14721	July 29	Decided.	Heavy, brown.	0.20	14.50	2.25	.0304	.0492	.0196	.0296	1.71	.0800	.0125	.4466	5.9
14900	Aug. 22	Distinct.	Cons., rusty.	0.20	15.40	3.20	.0760	.0110	.0100	.0010	1.70	.1000	.0100	.3900	5.6
15220	Sept. 19	Slight.	Slight.	0.27	17.80	3.10	.2080	.0150	.0150	.0000	2.03	.0850	.0090	.3822	6.6
15257	Sept. 26	Slight.	Slight.	0.20	17.10	2.70	.1680	.0260	.0210	.0050	1.88	.0560	.0065	.3159	6.0
15421	Oct. 24	Distinct, milky.	Slight.	1.20	10.60	2.40	.1300	.0250	.0240	.0010	0.92	.0370	.0015	.6926	3.6
15589	Nov. 21	Distinct.	Cons.	0.95	6.80	2.70	.0288	.0232	.0192	.0040	0.42	.0280	.0007	.6068	2.2
15776	Dec. 19	Distinct, milky.	V. slight.	0.90	9.70	3.20	.1200	.0410	.0340	.0070	0.76	.0470	.0014	.4697	3.5
Av.*	....	....	....	0.64	10.56	2.44	.1081	.0315	.0243	.0072	1.05	.0439	.0037	.4955	3.9

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

Odor, generally musty, frequently disagreeable or offensive. The iron was determined in the first five samples, the average amount being .0756.——The samples were collected from the canal leading from the upper dam of the Calumet Woolen Company to the mill, just before the water passed the screens.

Microscopical Examination.

The number of organisms found in these samples varied from 38 to 1034 per cubic centimeter, and averaged 401, *Zoöglœa* being generally the most abundant, and averaging 354.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River at Millville, Blackstone.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
13687	Jan. 17	Distinct, milky.	Cons., rusty.	0.68	7.70	2.10	.0840	.0310	.0250	.0060	0.77	.0150	.0007	.5016	2.6
13875	Feb. 21	Distinct.	Slight.	0.62	7.10	1.50	.1000	.0250	.0150	.0100	0.68	.0130	.0012	.4680	2.5
14032	Mar. 21	Distinct.	Slight.	0.63	5.60	2.10	.0640	.0270	.0210	.0060	0.58	.0220	.0007	.5056	2.1
14186	Apr. 18	Distinct.	Cons., rusty.	0.60	4.60	2.10	.0152	.0170	.0132	.0038	0.40	.0130	.0003	.4503	1.4
14358	May 23	Decided.	Cons., rusty.	0.60	5.40	2.30	.0400	.0280	.0160	.0120	0.50	.0180	.0011	.4902	2.2
14513	June 20	Distinct.	Slight.	0.40	9.00	2.80	.0600	.0200	.0140	.0060	0.86	.0200	.0065	.3705	3.4
14728	July 29	Slight.	Slight.	0.28	8.90	1.60	.0108	.0216	.0188	.0028	1.04	.0400	.0013	.3465	3.9
14899	Aug. 22	Slight, milky.	Slight.	0.20	11.20	3.70	.0140	.0208	.0156	.0052	1.30	.0750	.0025	.3354	4.2
15273	Sept. 27	Distinct, milky.	Slight, brown.	0.30	10.20	2.10	.0680	.0276	.0220	.0056	1.20	.0530	.0025	.3042	3.5
15425	Oct. 24	Distinct, milky.	Slight, brown.	0.95	7.30	3.00	.0410	.0230	.0190	.0040	0.57	.0220	.0008	.7605	2.3
15590	Nov. 21	Distinct.	Cons.	0.95	5.40	2.10	.0200	.0268	.0188	.0080	0.42	.0200	.0005	.6318	1.8
15778	Dec. 19	Distinct, milky.	Slight.	0.70	7.30	1.80	.0840	.0360	.0290	.0070	0.55	.0230	.0007	.4851	2.5
Av.	....	....	....	0.58	7.47	2.27	.0501	.0253	.0189	.0064	0.74	.0278	.0016	.4708	2.7

Odor, musty and frequently also disagreeable. The iron was determined in the first five samples, the average amount being .0714. —— The samples were collected from the river, just above the dam in the village of Millville.

Microscopical Examination.

The number of organisms found in these samples varied from 131 to 909 per cubic centimeter, and averaged 398, *Zoöglœa* being generally the most abundant, and averaging 250.

Special Examination of the Blackstone River and Worcester Precipitation Works in September, 1895.

The examination was made during the week ending Sept. 11, 1895, and was conducted as nearly as possible in the same manner as the examination made in July, 1891, described on page 267 of the report of the State Board of Health for 1891.

The method of collecting the sewage of Worcester and conveying it to the precipitation works remains the same as in 1891. Nearly all of the sewage of the city is discharged into Mill Brook, the channel

of which has practically been converted into a sewer, having an outlet into the Blackstone River at Quinsigamond Village. The main sewer leading to the precipitation works leads out of the Mill Brook channel near its lower end, and under ordinary conditions the whole flow of Mill Brook is diverted into the sewer by means of a dam, but at times a portion of the flow of the brook passes over the dam and enters the river without treatment.

In addition to the sewage of the city of Worcester, Mill Brook receives the natural drainage from a watershed of about 12.5 square miles, and its flow is consequently subject to great fluctuations. The character of the sewage of Worcester has been fully described in previous reports. Its composition is very variable, both on account of the fact that the sewage is mingled with the water of Mill Brook and on account of the large amount of manufacturing sewage which it receives, and which contains, at times, large amounts of iron salts discharged from the iron wire works in the city.

At the time of the examination in 1891 the normal capacity of the precipitation works was about 5,000,000 gallons per day, and during the examination a little over 6,000,000 gallons per day of sewage from the Mill Brook sewer was treated at the works. A much larger amount than this was conveyed to the works, but the excess was discharged untreated through a by-pass, and entered the river with the effluent. The works were enlarged in 1893, and the new works, which are said to have a capacity of 15,000,000 gallons per day, and to be capable of treating with good results a somewhat larger quantity, are thought to be of sufficient capacity to take the whole flow of Mill Brook under ordinary conditions.

The amount treated during the examination in 1895 averaged about 13,000,000 gallons per day, somewhat over twice the amount treated at the works during the previous examination, and all of the mingled sewage and brook water conveyed to the works was treated, the by-pass being closed.

The general results of the examinations of 1895 are shown in the tables which follow, while the detailed results are shown in tables beginning on page 376. For convenience in comparing the results of the examination of 1895 with the examination in 1891, the general results for the latter examination are reprinted, as far as is practicable, in the tables of general results which follow. The total

volume flowing in the various channels during each examination is given in the table on page 374. From this table it will be seen that the average flow in Mill Brook channel was somewhat greater in 1895 than in 1891, and that a very small proportion of the flow of Mill Brook was discharged into the river without treatment, as compared with the volume discharged in this way in 1891. The discharge of sewage directly into the river during the examination of 1895 was caused partly by leakage past the dam and partly by a shower which began at about 10 P.M. on the night of Monday, September 10, and caused the water in Mill Brook to overflow the dam. The total flow of the river below the precipitation works averaged 26,830,000 gallons per day in 1895, as compared with 35,840,000 gallons per day in 1891.

The amount of lime per 1,000,000 gallons used for the purification of the sewage during the week of the examination was considerably in excess of the average amount used during the year, and the purification of the sewage attained was greater than is ordinarily attained in the operation of the works. The results of the examination show that the condition of the river below the place where the effluent from the Worcester precipitation works is discharged, and in the town of Milbury, was practically the same as at the time of the special examination in 1891.

BLACKSTONE RIVER.

Comparison of Analyses of Sewage and Effluent from the Worcester Precipitation Works during the Week ending July 29, 1891, and the Week ending Sept. 11, 1895.

[Parts per 100,000.]

	1891.			1895.		
	Sewage.	Effluent.	Per Cent. Decrease or Increase.	Sewage.	Effluent.	Per Cent. Decrease or Increase.
Residue on evaporation, —						
Total,	92.86	52.65	43 decrease.	90.79	56.85	37 decrease.
Dissolved,	44.13	46.64	6 increase.	54.84	54.27	1 decrease.
Suspended,	48.73	6.01	88 decrease.	35.95	2.58	93 decrease.
Loss on ignition,	28.31	12.60	56 decrease.	37.33	11.09	70 decrease.
Dissolved,	13.29	11.28	15 decrease.	19.11	9.99	48 decrease.
Suspended,	15.02	1.32	91 decrease.	18.22	1.10	94 decrease.
Fixed residue,	64.55	40.05	38 decrease.	53.46	45.76	14 decrease.
Dissolved,	30.84	35.36	15 increase.	35.73	44.28	24 increase.
Suspended,	33.77	4.69	86 decrease.	17.73	1.48	92 decrease.
Free ammonia,	1.2684	1.1829	7 decrease.	1.3694	1.3268	3 decrease.
Albuminoid ammonia,	.4509	.1994	56 decrease.	.6397	.2477	61 decrease.
Dissolved,	.1510	.1588	5 increase.	.2452	.1996	19 decrease.
Suspended,	.2999	.0406	86 decrease.	.3945	.0481	88 decrease.
Chlorine,	5.33	4.77	11 decrease.	6.34	6.32	-
Nitrogen as nitrates,	.0575	.0542	6 decrease.	.0155	.0179	15 increase.
Nitrogen as nitrites,	.0103	.0562	446 increase.	.0155	.0321	107 increase.
Oxygen consumed, —						
Unfiltered,	4.9126	1.0583	78 decrease.	7.7654	2.4950	68 decrease.
Filtered,	1.5728	.8116	48 decrease.	4.0071	2.2602	44 decrease.
Iron oxide (Fe_2O_3),	10.75	0.41	96 decrease.	10.08	0.18	98 decrease.
Lime (CaO),	3.33	12.74	283 increase.	3.11	14.12	354 increase.
Sulphuric acid (SO_3),	14.84	15.66	6 increase.	17.47	16.54	5 decrease.
Bacteria per cubic centimeter,	209,592	14,458	93 decrease.	1,652,000	2,624,000	59 increase.

NOTE. — The bacteriological examinations were made Sept. 15, 1891, and Oct. 12, 1895. The number of bacteria in the sewage, as above given, is the average of two or three determinations, made at different hours during the day.

BLACKSTONE RIVER.

Comparison of Analyses, made during Week ending July 29, 1891, and Week ending Sept. 11, 1895, of the Water of the Blackstone River above and below the Points where the Worcester Sewage and Sewage Effluent are discharged.

[Parts per 100,000.]

	1891.			1895.		
	Above Mill Brook Channel.	Between Mill Brook Channel and the Precipitation Works.	Below the Precipitation Works.	Above Mill Brook Channel.	Between Mill Brook Channel and the Precipitation Works.	Below the Precipitation Works.
Color,	0.95	.44	.33	.95	.20	.33
Residue on evaporation, —						
Total,	6.94	27.84	35.89	8.65	23.46	39.41
Dissolved,	-	16.71	23.69	-	19.11	35.31
Suspended,	-	11.13	12.20	-	4.35	4.10
Loss on ignition,	2.58	8.37	9.55	3.47	5.17	8.17
Dissolved,	-	5.19	5.86	-	4.16	7.12
Suspended,	-	3.18	3.69	-	1.01	1.05
Fixed residue,	4.36	19.47	26.34	5.18	18.29	31.24
Dissolved,	-	11.52	17.83	-	14.95	28.19
Suspended,	-	7.95	8.51	-	3.34	3.05
Free ammonia,	.0166	.2699	.6233	.0309	.2627	.7574
Albuminoid ammonia,	.0489	.1168	.1869	.0477	.0678	.2128
Dissolved,	.0318	.0415	.0780	.0392	.0377	.1670
Suspended,	.0171	.0753	.1089	.0085	.0301	.0458
Chlorine,	.27	1.67	2.48	.65	1.23	3.52
Nitrogen as nitrates,	.0117	.0134	.0115	.0030	.0102	.0086
Nitrogen as nitrites,	.0001	.0026	.0052	.0010	.0015	.0105
Oxygen consumed, —						
Unfiltered,	.7030	1.3241	1.7809	.7416	1.5182	1.8428
Filtered,	-	.4246	.6606	-	1.2094	1.6115
Iron oxide, (Fe_2O_3),	0.36	4.45	3.52	0.20	3.33	2.05
Lime (Ca O),	0.77	1.60	4.33	0.95	2.41	7.90
Sulphuric acid (SO_3),	0.80	5.39	7.62	1.10	7.91	11.80
Bacteria per cubic centimeter,	77,750	47,550	16,650	17,000	2,000	9,000

NOTE. — The bacteriological examinations were made Sept. 15, 1891, and Oct. 12, 1895.

BLACKSTONE RIVER.

Comparison of Analyses, made during the Week ending July 29, 1891, of the Water of the Blackstone River, from a Point just below the Precipitation Works at Worcester to Millville. This Table represents the Portion of the River where the Pollution of the Water is decreasing as the Distance from Worcester increases.

	1891.				
	Below Precipitation Works, Worcester.	Outlet of Morse's Mill-pond, Millbury.	Below Last Dam in Millbury.	Dam of Calumet Woolen Co., Uxbridge.	Above Dam at Millville.
Area of watershed (sq. miles),	64.6	70.6	83.9	145.9	258.1
Relative sizes of watersheds,	1.00	1.09	1.30	2.26	4.00
Color,	.33	.10	.10	.24	.26
Residue on evaporation, —					
Total,	35.89	28.50	20.60	11.07	7.49
Dissolved,	23.69	23.20	16.00	-	-
Suspended,	12.20	5.30	4.60	-	-
Loss on ignition,	9.55	7.50	3.80	2.59	2.49
Dissolved,	5.86	5.10	2.40	-	-
Suspended,	3.69	2.40	1.40	-	-
Fixed residue,	26.34	21.00	16.80	8.48	5.00
Dissolved,	17.83	18.10	13.60	-	-
Suspended,	8.51	2.90	3.20	-	-
Free ammonia,	.6233	.6070	.5010	.2506	.0873
Albuminoid ammonia,	.1869	.1060	.0590	.0345	.0214
Dissolved,	.0780	.0420	.0280	.0271	.0163
Suspended,	.1089	.0640	.0310	.0074	.0051
Chlorine,	2.48	2.85	1.71	0.87	0.52
Nitrogen as nitrates,	.0115	.0060	.0070	.0443	.0359
Nitrogen as nitrites,	.0052	.0000	.0001	.0004	.0002
Oxygen consumed, —					
Unfiltered,	1.7809	1.0455	.5830	.1330	.4270
Filtered,	.6606	.5030	.4705	.1170	.2730
Iron oxide (Fe_2O_3),	3.52	3.87	1.00	0.17	0.12
Lime (Ca O),	4.33	4.39	3.63	1.99	1.12
Sulphuric acid, (SO_3),	7.62	9.30	7.19	3.43	1.75
Bacteria per cubic centimeter,	16,650	84,600	-	-	-

NOTE. — The bacteriological examinations were made Sept. 15, 1891.

BLACKSTONE RIVER.

Comparison of Analyses, made during the Week ending Sept. 11, 1895, of the Water of the Blackstone River, from a Point just below the Precipitation Works at Worcester to Millville. This Table represents the Portion of the River where the Pollution of the Water is decreasing as the Distance from Worcester increases.

	1895.				
	Below Precipitation Works, Worcester.	Outlet of Morse's Mill-pond, Millbury.	Below Last Dam in Millbury.	Dam of Calumet Woolen Co., Uxbridge.	Above Dam at Millville.
Area of watershed (sq. miles),	64.6	70.6	83.9	145.9	258.1
Relative sizes of watersheds,	1.00	1.09	1.30	2.26	4.00
Color,	0.33	0.80	0.27	0.18	0.25
Residue on evaporation, —					
Total,	39.41	37.00	28.60	16.50	10.79
Dissolved,	35.31	34.90	25.70	-	-
Suspended,	4.10	2.10	2.90	-	-
Loss on ignition,	8.17	4.70	5.60	3.70	2.51
Dissolved,	7.12	4.50	5.10	-	-
Suspended,	1.05	0.20	0.50	-	-
Fixed residue,	31.24	32.30	23.00	12.80	8.28
Dissolved,	28.19	30.40	20.60	-	-
Suspended,	3.05	1.90	2.40	-	-
Free ammonia,	.7574	.9210	.6750	.0947	.0298
Albuminoid ammonia,	.2128	.1040	.0740	.0223	.0205
Dissolved,	.1670	.0755	.0515	.0181	.0178
Suspended,	.0458	.0285	.0225	.0042	.0027
Chlorine,	3.52	3.57	2.82	1.75	1.13
Nitrogen as nitrates,	.0086	.0000	.0000	.0750	.0426
Nitrogen as nitrites,	.0105	.0002	.0102	.0064	.0018
Oxygen consumed, —					
Unfiltered,	1.8428	1.5870	1.2675	.3648	.3746
Filtered,	1.6115	1.5650	1.1505	-	-
Iron oxide (Fe_2O_3),	2.05	1.35	0.37	.07	.08
Lime (Ca O),	7.90	8.91	6.65	3.44	2.06
Sulphuric acid (SO_3),	11.80	13.12	9.30	4.07	2.41
Bacteria per cubic centimeter,	9,000	94,000	-	-	-

NOTE. — The bacteriological examinations were made Oct. 12, 1895.

BLACKSTONE RIVER.

Comparison of Analyses of Water from the Blackstone River in Millbury, above Singletary Brook, made in 1872, 1875, 1881, 1891 and 1895.

[Parts per 100,000.]

	Nov. 8, 1872.	July, 1875.	Average of Two Analyses, Aug. 30 and Oct. 2, 1881.	Average of Two Analyses, July 24 and 25, 1891.	Average of Two Analyses, Sept. 6 and 7, 1895.
Total residue on evaporation,	6.20	8.04	13.15	28.50	37.00
Loss on ignition,	-	-	3.35	7.50	9.70
Fixed residue,	-	-	9.80	21.00	32.30
Free ammonia,	.0450	.0992	.0793	.6070	.9210
Albuminoid ammonia,	.0400	.0307	.1176	.1060	.1040
Chlorine,	1.20	0.92	2.40	2.85	3.57

NOTE.—The sample analyzed in 1872 was collected just after a heavy rain which had greatly increased the flow of the river.

Average Daily Flow of Sewage, Sewage Effluent and River Water at Worcester during the Weeks beginning at 8 a.m., July 22, 1891, and 8 a.m., Sept. 4, 1895.

[Cubic feet per second.]

TWENTY-FOUR HOURS BEGINNING AT 8 A.M.	Sewage discharged directly into River at Mouth of Mill Brook.	Sewage discharged into River through by-pass at Precipitation Works.	Total Sewage discharged into River without Treatment.	Sewage Effluent discharged into River from Precipitation Works.	Flow of Mill Brook just above Point where Sewage is Diverted.	Flow of River just above Mill Brook.	Flow of River between Mill Brook and Precipitation Works.	Flow of River below Precipitation Works.
1891.								
Wednesday, July 22,	12.00	1.98	13.98	9.04	23.02	28.48	40.48	51.50
Thursday, July 23,	12.16	0.72	12.88	9.41	22.29	41.71	53.87	64.00
Friday, July 24,	12.59	1.52	14.11	9.46	23.57	51.62	64.21	75.19
Saturday, July 25,	10.35	1.22	11.57	8.84	20.41	42.93	53.28	63.34
Sunday, July 26,	0.64	1.48	2.12	9.20	11.32	23.25	23.89	34.57
Monday, July 27,	3.73	5.40	9.13	9.69	18.82	23.63	27.36	42.45
Tuesday, July 28,	4.80	2.78	7.58	9.50	17.08	39.95	44.75	57.03
Average,	8.04	2.16	10.20	9.30	19.50	35.94	43.98	55.44
Average in million gallons per day,	5.20	1.40	6.60	6.01	12.61	23.23	28.43	35.84
1895.								
Wednesday, September 4,	.06	-	.06	21.07	21.13	20.40	20.46	41.53
Thursday, September 5,	.06	-	.06	24.49	24.55	17.97	18.03	42.52
Friday, September 6,	.06	-	.06	20.39	20.45	20.68	20.74	41.13
Saturday, September 7,	.06	-	.06	20.41	20.47	13.22	13.28	33.69
Sunday, September 8,	.06	-	.06	11.83	11.89	3.63	3.69	15.52
Monday, September 9,	.40	-	.40	31.98	32.38	42.47	42.87	74.85
Tuesday, September 10,	.09	-	.09	19.04	19.13	22.17	22.26	41.30
Average,	.11	-	.11	21.32	21.43	20.08	20.19	41.51
Average in million gallons per day,	.07	-	.07	13.78	13.85	12.98	13.05	26.83

BLACKSTONE RIVER.

In the following tables are given the detailed results of the examinations of 1895.

As already stated, the samples were taken in the same manner and at the same places as in 1891. In collecting the samples of sewage for chemical analysis one bottle was filled every six hours, and its contents were made up of twelve equal half-hourly collections. The samples of effluent were collected in the same way, but, as the amount of sewage being treated required about six hours for its passage through the tanks, the samples of effluent were taken six hours later than the corresponding samples of sewage. In collecting the samples from the river above and below the precipitation works three bottles were filled every twenty-four hours, each bottle being made up of two or three equal portions. From other points on the river and its tributaries only one sample per day was collected, but wherever it was practicable this sample was made up of from two to four equal portions.

BLACKSTONE RIVER.

Chemical Examination of Worcester Sewage,

[Parts per 100,000.]

	Number.	Date of — Collection — 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total Residue. Total.	Dissolved.	Suspended.
		September.	Sept.						
1	14972	4, 8 A.M. to 2 P.M.	5	Thick, black.	Heavy, black.	*	92.00	62.00	30.00
2	14981	4, 2 P.M. to 8.30 P.M.	5	Decided, milky.	Heavy, black.	0.33	74.00	53.40	20.60
3	14995	4-5, 8 P.M. to 2 A.M.	5	Distinct, dark.	Heavy, dark.	0.40	100.40	76.40	24.00
4	14992	5, 2 A.M. to 8 A.M.	5	Decided, milky.	Cons., yellow.	0.90	31.60	20.80	10.80
5	15006	5, 8 A.M. to 2 P.M.	6	Thick, black.	Heavy, black.	*	98.60	68.40	30.20
6	15010	5, 2 P.M. to 8 P.M.	6	Decided, milky.	Heavy, black.	0.70	86.40	61.60	24.80
7	15015	5-6, 8 P.M. to 2 A.M.	6	Distinct, milky.	Heavy, dark.	0.60	102.40	75.40	27.00
8	15017	6, 2 A.M. to 8 A.M.	6	Decided, milky.	Cons., brown.	0.15	33.80	20.60	13.20
9	15023	6, 8 A.M. to 2 P.M.	7	Thick, dark.	Heavy, black.	1.50	100.40	69.20	31.20
10	15030	6, 2 P.M. to 8 P.M.	7	Decided, dark.	Heavy, black.	0.70	81.60	59.60	22.00
11	15034	6-7, 8 P.M. to 2 A.M.	7	Distinct, milky.	Heavy, dark.	0.70	89.40	66.40	23.00
12	15036	7, 2 A.M. to 8 A.M.	7	Distinct, milky	Cons., floc.	0.25	53.60	49.00	4.60
13	15053	7, 8 A.M. to 2 P.M.	8	Thick, black.	Heavy, black.	1.00	95.20	72.00	23.20
14	15054	7, 2 P.M. to 8 P.M.	8	Thick, black.	Heavy, black.	0.90	87.40	58.80	28.60
15	15061	7-8, 8 P.M. to 2 A.M.	8	Dec'd, yellow.	Heavy, dark.	1.30	126.60	103.80	22.80
16	15062	8, 2 A.M. to 8 A.M.	8	Dec'd, brown.	Heavy, brown.	1.30	41.40	26.60	14.80
17	15063	8, 8 A.M. to 2 P.M.	8	Thick, yellow.	Heavy, black.	2.00	57.60	35.20	22.40
18	15074	8, 2 P.M. to 8 P.M.	9	Decided, milky.	Heavy, dark.	1.50	50.40	35.40	15.00
19	15088	8-9, 8 P.M. to 2 A.M.	9	Decided, thick.	Heavy, black.	0.30	67.00	41.80	25.20
20	15090	9, 2 A.M. to 8 A.M.	9	Decided, milky.	Cons., brown.	1.00	47.00	26.20	20.80
21	15100	9, 8 A.M. to 2 P.M.	10	Thick, black.	Heavy, black	1.00	96.60	64.00	32.60
22	15114	9, 2 P.M. to 8 P.M.	10	Distinct, gray.	V. heavy, black.	0.60	105.40	61.00	44.40
23	15118	9-10, 8 P.M. to 2 A.M.	10	Thick, dark.	V. heavy, dark.	0.38	181.40	53.00	128.40
24	15120	10, 2 A.M. to 8 A.M.	10	Thick, brown.	Cons., dark.	2.00	102.20	18.60	83.60
25	15140	10, 8 A.M. to 2 P.M.	11	Thick, black.	Heavy, black.	0.90	125.20	96.20	29.00
26	15142	10, 2 P.M. to 8 P.M.	11	Distinct, milky.	V. heavy, black.	0.50	91.60	70.20	21.40
27	15150	10-11, 8 P.M. to 2 A.M.	11	Decided, milky.	Heavy, floc.	0.30	277.20	69.20	208.00
28	15152	11, 2 A.M. to 8 A.M.	11	Decided, milky.	Heavy, dark.	0.40	45.60	20.60	25.00
29	Av...	....	.....	....	....	-	90.79	54.84	35.95

Averages of the Above

		Color.	Total.	Dissolved.	Suspended.
30	For the 24 hours beginning at 8 A.M., Wednesday, September 4,	0.54	74.50	53.15	21.35
31	For the 24 hours beginning at 8 A.M., Thursday, September 5,	0.48	80.30	56.50	23.80
32	For the 24 hours beginning at 8 A.M., Friday, September 6,	0.79	81.25	61.05	20.20
33	For the 24 hours beginning at 8 A.M., Saturday, September 7,	1.13	87.65	65.30	22.35
34	For the 24 hours beginning at 8 A.M., Sunday, September 8,	1.20	55.50	31.65	20.85
35	For the 24 hours beginning at 8 A.M., Monday, September 9,	1.00	121.40	49.15	72.25
36	For the 24 hours beginning at 8 A.M., Tuesday, September 10,	0.53	134.90	64.05	70.85
37	Average,	-	90.79	54.84	35.95

Averages of Samples collected at

		Color.	Total.	Dissolved.	Suspended.
38	For the hours from 8 A.M. to 2 P.M.,	1.28	95.09	66.71	28.37
39	For the hours from 2 P.M. to 8 P.M.,	0.75	82.40	57.14	25.26
40	For the hours from 8 P.M. to 2 A.M.,	0.57	134.91	69.43	65.48
41	For the hours from 2 A.M. to 8 A.M.,	0.86	50.74	26.06	24.68
42	Average,	-	90.79	54.84	35.95

Odor, offensive. —— The samples were collected from the chamber at the outlet of the sewer leading treated with chemicals. A sample was collected every six hours and was made up of twelve equa

* Too turbid to determine.

BLACKSTONE RIVER.

collected just above the Precipitation Works.

[Parts per 100,000.]

Residue on Evaporation — Con. Loss on Ignition. Total.	Dissolved.	Suspended.	Ammonia. Free.	Albuminoid. Total.	Dissolved.	Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed. Unfiltered.	Filtered.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
41.00	20.40	20.60	1.7540	0.7300	.2120	.5180	7.55	.0050	.0000	10.6260	5.2514	8.26	2.94	19.53	1
36.60	20.60	16.00	1.1540	0.6440	.2280	.4160	7.05	.0150	.0166	14.3374	4 3505	7.33	3.06	15.69	2
40.20	30.60	9.60	1.1160	0.6460	.4040	.2420	6.65	.0080	.0067	7.5075	4.6200	17.82	2.92	28.68	3
11.40	5.00	6.40	0.4560	0.1440	.0520	.0920	2.40	.0900	.0135	1.7864	1.0395	2.72	2.76	6.41	4
42.60	22.60	20.00	1.8560	0.6080	.2480	.3600	7.80	.0000	.0200	12.1680	6.0060	13.41	3.16	21.56	5
38.20	22.20	16.00	0.9880	0.6380	.2420	.3960	7.50	.0100	.0120	9.1260	5.4600	2.91	3.06	18.43	6
43.80	31.80	12.00	1.0480	0.6980	.4420	.2560	7.60	.0060	.0200	8.1900	5.1870	18.87	2.84	28.42	7
10.40	4.40	6.00	0.4780	0.1380	.0620	.0760	3.00	.1000	.0320	2.1840	1.4040	3.12	2.70	8.09	8
44.80	29.00	15.80	1.9520	0.5880	.2140	.3740	8.95	.0050	.0020	8.9310	4.5630	13.27	3.94	22.63	9
36.60	21.40	15.20	1.3720	0.7160	.2800	.4360	7.50	.0070	.0350	7.4100	5.7090	10.05	3.02	18.21	10
36.80	18.40	18.40	1.1140	0.3820	.1980	.1840	7.30	.0100	.0150	6.4350	4.3680	12.86	3.26	25.56	11
20.20	18.20	2.00	0.4940	0.1160	.0580	.0580	2.20	.0300	.0150	2.8860	2.4960	12.32	1.56	20.42	12
45.00	23.20	21.80	1.9560	0.7620	.2260	.5360	6.90	.0050	.0048	8.9700	5.1480	15.83	3.00	26.12	13
40.20	19.60	20.60	1.5060	1.0960	.3740	.7220	9.40	.0020	.0400	9.1260	4.4694	7.55	4.52	15.64	14
48.40	45.60	2.80	1.4380	0.6740	.4360	.2380	7.00	.0040	.0120	9.1650	6.4740	27.16	3.48	43.12	15
12.60	6.00	6.60	1.0080	0.3680	.0600	.3080	3.80	.0020	.0002	2.9250	1.4430	2.64	3.42	7.16	16
25.80	5.60	20.20	3.2600	0.6100	.1800	.4300	5.45	.0080	.0002	4.7970	2.7300	3.95	3.46	8.53	17
17.20	8.40	8.80	2.4560	0.7160	.2560	.4600	8.60	.0020	.0004	4.6800	2.3400	2.62	2.92	5.45	18
24.20	9.20	15.00	2.2060	0.6180	.1500	.4680	6.45	.0020	.0000	4.4460	2.2230	8.73	3.38	13.61	19
19.60	8.00	11.60	1.0360	0.4900	.0960	.3940	3.50	.0250	.0360	3.5880	1.0530	3.30	3.58	7.14	20
40.80	18.80	22.00	2.7240	1.1060	.6660	.4400	6.85	.0000	.0004	11.3100	4.0560	9.67	3.90	15.54	21
59.00	24.00	35.00	1.5240	1.0660	.4420	.6240	8.45	.0100	.0160	9.5940	6.7808	9.31	3.12	14.73	22
54.60	19.20	35 40	0.9040	1.1640	.2520	.9120	4.00	.0000	.0250	12.7140	3.8220	16.03	2.94	19.33	23
22.00	4.20	17.80	0.2440	0.3820	.0800	.3020	2.25	.0200	.0277	7.4100	2.1450	4.22	2.60	4.70	24
50.40	41.60	8.80	1.5740	0.5360	.2100	.3260	7.60	.0080	.0125	10.7640	6.8250	21.61	3.22	29.84	25
40.80	26.80	14.00	1.1440	0.8900	.5580	.3320	9.80	.0020	.0300	8.5800	6.7860	9.47	2.86	18.43	26
124.80	24.80	100.00	1.1160	1.1460	.1920	.9540	9.10	.0080	.0160	13.3380	4.1340	15.10	2.86	21.17	27
17.20	5.60	11.60	0.4660	0.2400	.0480	.1920	2.90	.0500	.0260	4.4380	1.3880	2.22	2.64	5.08	28
37.33	19.11	18.22	1.3694	0.6397	.2452	.3945	6.34	.0155	.0155	7.7654	4.0071	10.08	3.11	17.47	29

Samples by Days.

32.30	19.15	13.15	1.1200	.5410	.2240	.3170	5.91	.0295	.0092	8.5643	3.8154	9.03	2.92	17.58	30
33.75	20.25	13.50	1.0925	.5205	.2485	.2720	6.48	.0290	.0210	7.9170	4.5143	9.58	2.94	19.13	31
34.60	21.75	12.85	1.2330	.4505	.1875	.2630	6.49	.0130	.0168	6.4155	4.2840	12.13	2.95	21.71	32
36.55	23.60	12.95	1.4770	.7250	.2740	.4510	6.78	.0033	.0143	7.5465	4.3836	13.30	3.61	23.01	33
21.70	7.80	13.90	2.2395	.6085	.1705	.4380	6.00	.0093	.0091	4.3778	2.0865	4.65	3.34	8.68	34
44.10	16.55	27.55	1.3490	.9295	.3600	.5695	5.39	.0075	.0173	10.2570	4.1828	9.81	3.14	13.58	35
58.30	24.70	33.60	1.0750	.7030	.2520	.4510	7.35	.0170	.0211	9.2800	4.7833	12.10	2.90	18.63	36
37.33	19.11	18.21	1.3694	.6397	.2452	.3945	6.34	.0155	.0155	7.7654	4.0071	10.08	3.11	17.47	37

Corresponding Hours during the Week.

41.49	23.03	18.46	2.1537	.7057	.2794	.4263	7.30	.0044	.0057	9.6523	4.9399	12.29	3.37	20.54	38
38.37	20.43	17.94	1.4491	.8237	.3400	.4837	8.33	.0069	.0214	8.9791	5.1176	7.03	3.22	15.23	39
53.26	25.66	27.60	1.2774	.7611	.2963	.4648	6.87	.0054	.0135	8.8279	4.4040	16.65	3.10	25.70	40
16.20	7.34	8.86	0.5974	.2683	.0651	.2031	2.86	.0453	.0215	3.6025	1.5669	4.36	2.75	8.43	41
37.33	19.11	18.21	1.3694	.6397	.2452	.3945	6.34	.0155	.0155	7.7654	4.0071	10.08	3.11	17.47	42

to the precipitation works, just in front of the screen through which the sewage passes before being portions, collected at half-hour intervals. The first collection was made at 8 A. M., Sept. 4, 1895.

BLACKSTONE RIVER.

Chemical Examination of Effluent from

[Parts per 100,000.]

	Number.	Date of— Collection — 1895.	Date of— Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total Residue. Total.	Residue on Evaporation. Total Residue. Dissolved.	Residue on Evaporation. Total Residue. Suspended.
		September.	Sept.						
1	14982	4, 2 P.M. to 8 P.M.	5	Decided.	Slight, yellow.	.35	62.40	59.20	3.20
2	14991	4-5, 8 P.M. to 2 A.M.	5	Decided, milky.	Slight, yellow.	.25	61.60	60.10	1.50
3	14996	5, 2 A.M. to 8 A.M.	5	Distinct, milky.	Slight, light.	.30	63.40	62.20	1.20
4	15007	5, 8 A.M. to 2 P.M.	6	Decided.	Slight, rusty.	.30	46.60	45.40	1.20
5	15011	5, 2 P.M. to 8 P.M.	6	Decided, milky.	Slight, rusty.	.30	61.40	60.00	1.40
6	15016	5-6, 8 P.M. to 2 A.M.	6	Decided, milky.	Slight, yellow.	.30	67.20	62.20	5.00
7	15018	6, 2 A.M. to 8 A.M.	6	Decided, milky.	Slight, yellow.	.30	56.60	56.20	0.40
8	15024	6, 8 A.M. to 2 P.M.	7	Distinct, milky.	Slight, yellow.	.20	43.80	43.40	0.40
9	15031	6, 2 P.M. to 8 P.M.	7	Decided, milky.	Slight, rusty.	.30	63.20	60.20	3.00
10	15035	6-7, 8 P.M. to 2 A.M.	7	Decided, milky.	V. slight, yellow.	.28	63.80	62.80	1.00
11	15037	7, 2 A.M. to 8 A.M.	7	Decided, milky.	Slight, yellow.	.20	64.40	64.00	0.40
12	15055	7, 8 A.M. to 2 P.M.	8	Slight, rusty.	Slight, rusty.	.70	55.80	52.60	3.20
13	15056	7, 2 P.M. to 8 P.M.	8	Distinct, rusty.	Slight, rusty.	.15	68.60	63.80	4.80
14	15064	7-8, 8 P.M. to 2 A.M.	8	Decided, milky.	Slight, yellow.	.20	67.60	67.00	0.60
15	15065	8, 2 A.M. to 8 A.M.	8	Decided, milky.	Slight, yellow.	.25	69.80	65.80	4.00
16	15066	8, 8 A.M. to 2 P.M.	8	Decided, milky.	Slight, yellow.	.25	49.20	46.00	3.20
17	15075	8, 2 P.M. to 8 P.M.	9	Decided, milky.	Slight, brown.	.40	50.60	43.40	7.20
18	15089	8-9, 8 P.M. to 2 A.M.	9	Decided, milky.	Slight, rusty.	.35	49.20	43.80	5.40
19	15091	9, 2 A.M. to 8 A.M.	9	Distinct, milky.	Slight, rusty.	.30	43.60	39.40	4.20
20	15101	9, 8 A.M. to 2 P.M.	10	Decided, milky.	Slight, yellow.	.30	40.00	39.00	1.00
21	15115	9, 2 P.M. to 8 P.M.	10	Decided, milky.	Slight, dark.	.65	54.80	53.80	1.00
22	15119	9-10, 8 P.M. to 2 A.M.	10	Decided, milky.	Cons., dark.	.40	56.20	50.60	5.60
23	15121	10, 2 A.M. to 8 A.M.	10	Decided, milky.	Cons., brown.	.50	52.00	45.60	6.40
24	15141	10, 8 A.M. to 2 P.M.	11	Slight, rusty.	Cons., rusty.	.20	38.60	36.00	2.60
25	15143	10, 2 P.M. to 8 P.M.	11	Decided, milky.	Slight, rusty.	.40	58.40	58.00	0.40
26	15151	10-11, 8 P.M. to 2 A.M.	11	Decided, milky.	Slight, brown.	.40	72.00	71.80	0.20
27	15153	11, 2 A.M. to 8 A.M.	11	Distinct, milky.	Slight, brown.	.30	65.00	63.20	1.80
28	15156	11, 8 A.M. to 2 P.M.	12	Decided, milky.	Slight, yellow.	.25	46.00	44.00	2.00
29	Av.	....	.....	....	....	.32	56.85	54.27	2.58

Averages of the Above

		Color.	Total.	Dissolved.	Suspended.
30	For the 24 hours beginning at 2 P.M., Wednesday, September 4, . .	.30	58.50	56.73	1.77
31	For the 24 hours beginning at 2 P.M., Thursday, September 5, . .	.27	57.25	55.45	1.80
32	For the 24 hours beginning at 2 P.M., Friday, September 6, . . .	.37	61.80	59.90	1.90
33	For the 24 hours beginning at 2 P.M., Saturday, September 7, . .	.21	63.80	60.65	3.15
34	For the 24 hours beginning at 2 P.M., Sunday, September 8, . . .	.34	45.85	41.40	4.45
35	For the 24 hours beginning at 2 P.M., Monday, September 9, . . .	.44	50.40	46.50	3.90
36	For the 24 hours beginning at 2 P.M., Tuesday, September 10, . .	.34	60.35	59.25	1.10
37	Average, ...	.32	56.85	54.27	2.58

Averages of Samples collected

		Color.	Total.	Dissolved.	Suspended.
38	For the hours from 2 P.M. to 8 P.M., ...	.36	59.91	56.91	3.00
39	For the hours from 8 P.M. to 2 A.M., ...	.31	62.51	59.76	2.76
40	For the hours from 2 A.M. to 8 A.M., ...	.31	59.26	56.63	2.63
41	For the hours from 8 A.M. to 2 P.M., ...	.31	45.71	43.77	1.94
42	Average, ...	.32	56.85	54.27	2.58

Odor, offensive.——The samples were collected from the channel which conveys the effluent from up of twelve equal portions collected at half-hour intervals. The first collection was made at 2 P.M.,

BLACKSTONE RIVER.

the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Residue on Evaporation — Con.			Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.		Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
Loss on Ignition.				Albuminoid.											
Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.				
12.80	12.20	0.60	1.2340	.2180	.1860	.0320	6.80	.0200	.0240	2.3716	2.2946	0.02	18.30	19.06	1
13.60	13.00	0.60	1.1960	.2900	.2440	.0460	6.60	.0300	.0105	2.6565	2.2946	0.00	15.40	17.36	2
15.60	14.80	0.80	1.1160	.5720	.3860	.1860	6.80	.0400	.0090	3.0030	2.7720	0.10	22.24	16.82	3
9.80	8.60	1.20	0.8760	.2240	.1700	.0540	4.70	.0450	.0350	2.5740	2.1060	0.02	12.40	13.77	4
12.40	12.00	0.40	1.1880	.2160	.1820	.0340	6.55	.0450	.0444	2.7300	2.7300	0.02	15.08	19.06	5
13.60	11.20	2.40	1.4480	.2640	.2060	.0580	7.00	.0080	.0620	2.8860	2.8080	0.02	17.13	18.62	6
13.00	12.60	0.40	1.1420	.2340	.1920	.0420	6.40	.0200	.0600	2.7300	2.2620	0.06	15.14	17.62	7
8.80	8.00	0.80	1.0020	.1420	.1260	.0160	4.60	.0500	.0400	2.1840	1.4430	1.71	12.42	14.35	8
13.40	11.60	1.80	0.7020	.2060	.1620	.0440	6.70	.0300	.0500	3.1200	2.6910	0.02	16.10	19.73	9
10.60	10.40	0.20	1.3940	.2040	.1820	.0220	6.90	.0040	.0600	3.1200	2.8080	0.10	17.24	20.55	10
13 40	13.00	0.40	0.9560	.2020	.1920	.0100	6.90	.0050	.0670	2.5740	2.4336	0.19	17.20	20.50	11
8.40	7.80	0.60	0.9580	.1320	.1040	.0280	4.75	.0200	.0480	1.8330	1.7316	0.02	15.35	19.94	12
15.00	10.60	4.40	1.3780	.1980	.1600	.0380	6.40	.0180	.0200	2.6130	2.4336	0.16	18.72	23.57	13
13.20	12.60	0.60	1.3100	.2240	.1940	.0300	7.20	.0000	.0380	2.3790	2.3400	0.02	16.36	21.04	14
14.60	13.60	1.00	1.3100	.3460	.2700	.0760	7.30	.0140	.0440	2.4960	2.4180	0.06	15.84	20.51	15
11.20	10.20	1.00	1.4900	.1940	.1780	.0160	5.05	.0480	.0520	1.6770	1.5210	0.07	10.96	14.41	16
8.00	5.00	3.00	2.7760	.3500	.2520	.0980	6.70	.0200	.0460	1.8720	1.7940	0.21	10.64	13.00	17
6.80	6.40	0.40	2.0560	.2560	.1720	.0840	7.30	.0000	.0004	1.9890	1.9500	0.16	9.88	12.46	18
5.20	5.00	0.20	2.0560	.2040	.1760	.0280	6.40	.0150	.0520	1.7940	1.7160	0.22	9.66	12.40	19
7.00	6.60	0.40	1.6740	.2180	.1780	.0400	6.20	.0000	.0600	1.9890	1.9500	0.07	8.02	9.87	20
11.40	11.00	0.40	2.3240	.2960	.2640	.0320	7.40	.0020	.0000	2.9250	2.8470	0.04	11.30	13.71	21
8.80	6.20	2.60	1.5240	.2900	.2420	.0480	7.00	.0020	.0001	2.7300	2.4180	0 39	12.24	13.34	22
8.80	6.00	2.80	1.0540	.3320	.2340	.0980	5.30	.0020	.0001	2.9481	2.0980	0.76	11.20	13.30	23
6.80	6.80	0.00	0.5240	.1100	.0980	.0120	3.60	.0520	.0277	1.9110	1.7160	0.21	9.86	11.90	24
10.40	9.40	1.00	1.0240	.1980	.1600	.0380	5.30	.0000	.0300	2.4480	2.3400	0.21	14.92	19.72	25
15.00	14.20	0.80	1.4160	.3760	.2820	.0940	8.00	.0000	.0000	3.7830	3.1200	0.02	16.38	18.88	26
15.40	14.40	1.00	1.1660	.2820	.2520	.0300	7.80	.0000	.0000	2.7300	2.5350	0.02	14.46	16.36	27
7.60	6.60	1.00	0.8560	.1580	.1440	.0140	5.25	.0100	.0180	1.7940	1.7160	0.02	11.06	11.14	28
11.09	9.99	1.10	1.3268	.2477	.1996	.0481	**6.32**	.0179	.0321	2.4950	2.2602	0.18	14.12	16.54	29

Samples by Days.

12.95	12.15	0.80	1.1055	.3260	.2465	.0795	6.23	.0338	.0199	2.6513	2.3668	0.05	17.09	16.75	30
1.195	10.95	1.00	1.1950	.2140	.1765	.0375	6.14	.0308	.0516	2.6325	2.3107	0.45	14.94	17.41	31
11.45	10.70	0.75	1.0025	.1860	.1600	.0260	6.31	.0148	.0563	2.6618	2.4160	0.08	16.47	20.18	32
13.50	11.75	1.75	1.3720	.2405	.2005	.0400	6.49	.0200	.0385	2.2913	2.1781	0.08	15.47	19.88	33
6.75	5.75	1.00	2.1405	.2570	.1945	.0625	6.65	.0088	.0396	1.9110	1.8525	0.17	9.55	11.93	34
8.95	7.50	1.45	1.3565	.2570	.2095	.0475	5.83	.0145	.0070	2.6285	2.2697	0.35	11.15	13.06	35
12.10	11.15	0.95	1.1155	.2535	.2095	.0440	6.59	.0025	.0120	2.6888	2.4277	0.07	14.21	16.53	36
11.09	9.99	1.10	1.3268	.2477	.1996	.0481	6.32	.0179	.0321	2.4950	2.2602	0.18	14.12	16.53	37

at Corresponding Hours.

11.91	10.26	1.66	1.5180	.2403	.1951	.0451	6.55	.0193	.0306	2.5828	2.4472	0.10	15.01	18.26	38
11.66	10.57	1.09	1.4777	.2720	.2174	.0546	7.14	.0063	.0246	2.7919	2.5341	0.12	14.95	17.46	39
12.29	11.34	.94	1.2571	.3103	.2431	.0671	6.70	.0137	.0332	2.6107	2.3192	0.20	15.11	16.79	40
8.51	7.80	.71	1.0543	.1683	.1426	.0257	4.88	.0321	.0401	1.9946	1.7405	0.30	11.44	13.63	41
11.09	9.99	1.10	1.3268	.2477	.1996	.0481	6.32	.0179	.0321	2.4950	2.2602	0.18	14.13	16.54	42

the precipitation tank to the Blackstone River. A sample was collected every six hours, and was made Sept. 4, 1895.

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River at Dam of

[Parts per 100,000.]

	Number.	Date of — Collection, 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.
1	14980	Sept. 4	Sept. 5	Distinct.	Slight.	0.90	6.90	3.00
2	15005	5	6	Distinct.	Cons., brown.	0.90	8.50	2.70
3	15029	6	7	Distinct.	Cons., brown.	0.95	10.10	5.70
4	15052	7	8	Distinct.	Cons., brown.	0.90	8.90	4.40
5	15073	8	9	Distinct.	Cons., brown.	1.20	-	-
6	15113	9	10	Decided.	Cons., rusty.	0.90	8.70	2.50
7	15139	10	11	Decided.	Cons., brown.	0.90	8.80	2.50
8	Av...	....	....	....	....	0.95	8.65	3.47

Odor, vegetable and mouldy, sometimes also disagreeable. —— The samples were collected from the hours, beginning at 8 A.M.

BLACKSTONE RIVER.

Quinsigamond Iron and Wire Works, just above Mill Brook Channel.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
	Albuminoid.										
Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.					
.0250	.0448	.0384	.0064	.60	.0020	.0008	.7099	-	-	-	1
.0192	.0494	.0398	.0096	.56	.0120	.0010	.7063	-	-	-	2
.0264	.0528	.0414	.0114	.96	.0000	.0010	.7605	-	-	-	3
.0304	.0472	.0416	.0056	.60	.0050	.0010	.7644	-	-	-	4
.0424	.0466	.0398	.0068	-	.0000	.0012	.6981	-	-	-	5
.0440	.0438	.0340	.0098	.60	.0000	.0005	.7800	-	-	-	6
.0288	.0490	.0394	.0096	.60	.0020	.0012	.7722	-	-	-	7
.0309	.0477	.0392	.0085	.65	.0030	.0010	.7416	*.20	*.95	*1.10	8

river at the dam. Each sample was made up of four equal portions, collected at intervals of about four

* These determinations were made upon a mixture of equal parts of water from all the samples.

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River between the

[Parts per 100,000,]

	Number.	Date of— Collection — 1895.	Date of— Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total Residue. Total.	Residue on Evaporation. Total Residue. Dissolved.	Residue on Evaporation. Total Residue. Suspended.
		September.	Sept.						
1	14973	4, 8 A.M. to 2 P.M.	5	Decided, rusty.	Heavy, rusty.	0.03	16.80	13.60	3.20
2	14983	4, 2 P.M. to 8 P.M.	5	Distinct.	Heavy, rusty.	0.04	21.60	18.80	2.80
3	14994	4-5, 8 P.M. to 8 A.M.	5	Distinct.	Cons., rusty.	0.05	16.20	15.20	1.00
4	15008	5, 8 A.M. to 2 P.M.	6	Distinct.	Heavy, rusty.	0.08	17.00	13.60	3.40
5	15012	5, 2 P.M. to 8 P.M.	6	Slight.	Heavy, rusty.	0.10	22.40	19.40	3.00
6	15019	5-6, 8 P.M. to 8 A.M.	6	Decided, milky.	Slight, rusty.	0.04	14.40	13.00	1.40
7	15025	6, 8 A.M. to 2 P.M.	7	Dist't, yellow.	Cons., rusty.	0.30	19.80	18.60	1.20
8	15032	6, 2 P.M. to 8 P.M.	7	Slight, yellow.	Cons., rusty.	0.05	35.00	34.40	0.60
9	15038	6-7, 8 P.M. to 8 A.M.	7	Decided, milky.	Slight, rusty.	0.10	28.00	27.60	0.40
10	15057	7, 8 A.M. to 2 P.M.	8	V. slight, rusty.	Heavy, rusty.	0.10	26.60	23.00	3.60
11	15058	7, 2 P.M. to 8 P.M.	8	Slight, rusty.	Heavy, rusty.	0.10	17.80	14.20	3.60
12	15067	7-8, 8 P.M. to 8 A.M.	8	Distinct, milky.	Cons., brown.	0.50	51.20	47.00	4.20
13	15068	8, 8 A.M. to 2 P.M.	8	Decided, rusty.	Heavy, rusty.	0.25	21.20	18.40	2.80
14	15076	8, 2 P.M. to 8 P.M.	9	Decided, rusty.	Heavy, rusty.	0.70	22.20	20.80	1.40
15	15092	8-9, 8 P.M. to 8 A.M.	9	Distinct, milky.	Heavy, rusty.	0.30	24.20	18.80	5.40
16	15102	9, 8 A.M. to 2 P.M.	10	Slight, milky.	Heavy, rusty.	0.10	24.00	17.20	6.80
17	15116	9, 2 P.M. to 8 P.M.	10	Slight, milky.	Heavy, rusty.	0.10	16.80	11.00	5.80
18	15122	9-10, 8 P.M. to 8 A.M.	10	Thick, brown.	Cons., dark.	1.00	46.00	14.60	31.40
19	15144	10, 8 A.M. to 2 P.M.	11	Distinct, rusty.	Heavy, rusty.	0.15	20.80	16.00	4.80
20	15146	10, 2 P.M. to 8 P.M.	11	Decided, milky.	Heavy, rusty.	0.15	15.80	12.20	3.60
21	15154	10-11, 8 P.M. to 8 A.M.	11	Decided, milky.	Slight, rusty.	0.02	14.80	14.00	0.80
22	Av.	....	......	....	....	0.20	23.46	19.11	4.35

Averages of the Above

		Color.	Total.	Dissolved.	Suspended.
23	For the 24 hours beginning at 8 A.M., Wednesday, September 4, . .	0.04	18.20	15.87	2.33
24	For the 24 hours beginning at 8 A.M., Thursday, September 5, . .	0.07	17.93	15.33	2.60
25	For the 24 hours beginning at 8 A.M., Friday, September 6, . . .	0.15	27.60	26.87	0.73
26	For the 24 hours beginning at 8 A.M., Saturday, September 7, . . .	0.23	31.87	28.07	3.80
27	For the 24 hours beginning at 8 A.M., Sunday, September 8, . . .	0.42	22.53	19.33	3.20
28	For the 24 hours beginning at 8 A.M., Monday, September 9, . . .	0.40	28.93	14.27	14.67
29	For the 24 hours beginning at 8 A.M., Tuesday, September 10, . .	0.11	17.13	14.07	3.07
30	Average, ...	0.20	23.46	19.12	4.34

Averages of Samples collected

		Color.	Total.	Dissolved.	Suspended.
31	For the hours from 8 A.M. to 2 P.M., ...	0.14	20.89	17.20	3.69
32	For the hours from 2 P.M. to 8 P.M., ...	0.18	21.66	18.69	2.97
33	For the hours from 8 P.M. to 8 A.M., ...	0.29	27.83	21.46	6.37
34	Average, ...	0.20	23.46	19.12	4.34

Odor, tarry, often disagreeable.—— The samples were collected from the river, at a temporary bridge from these works enters the river.

Three samples were collected each twenty-four hours. The first was made up of three equal portions, collected at intervals of two hours, beginning at 3 P.M.; the third sample was made up of two

BLACKSTONE RIVER,

Mill Brook Channel and the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Residue on Evaporation — Con.			Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.		Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
Loss on Ignition.				Albuminoid.											
Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.				
2.20	2.00	0.20	0.2740	.0520	.0340	.0180	0.98	.0150	.0005	1.1550	0.8855	3.15	1.94	6.24	1
6.40	6.40	0.00	0.1440	.0320	.0140	.0180	1.00	.0030	.0005	1.2936	1.1935	4.49	1.46	7.47	2
4.20	4.00	0.20	0.1260	.0520	.0400	.0120	0.87	.0150	.0003	0.9240	0.7700	2.96	1.54	5.27	3
2.60	2.00	0.60	0.1960	.0440	.0260	.0180	0.88	.0120	.0011	1.6380	1.1700	2.89	1.88	5.88	4
5.60	4.80	0.80	0.1580	.0460	.0300	.0160	0.96	.0050	.0010	1.6380	1.5600	5.93	1.62	8.62	5
3.80	3.00	0.80	0.1220	.0320	.0160	.0160	0.83	.0100	.0009	1.3260	1.2090	2.11	1.44	5.91	6
4.80	3.60	1.20	0.1820	.0640	.0240	.0400	0.96	.0050	.0010	1.6770	1.1856	2.59	2.56	7.92	7
12.20	12.20	0.00	0.1840	.0660	.0240	.0420	0.89	.0000	.0006	2.1060	2.1060	2.60	1.88	13.96	8
9.80	9.80	0.00	0.1360	.0240	.0200	.0040	0.89	.0020	.0009	1.6770	1.6770	6.09	1.90	10.67	9
6.20	6.20	0.00	0.2280	.0180	.0140	.0040	0.90	.0060	.0004	1.3260	1.3260	6.27	1.84	11.63	10
2.40	1.40	1.00	0.1580	.0260	.0120	.0140	1.10	.0040	.0004	1.4040	1.1700	2.97	1.66	7.53	11
8.60	7.40	1.20	1.2100	.2940	.2000	.0940	5.50	.0000	.0000	2.2230	2.1060	0.78	12.54	16.29	12
2.80	1.80	1.00	0.4700	.0360	.0260	.0100	1.22	.0100	.0002	0.9360	0.7410	3.73	2.28	7.83	13
7.20	6.80	0.40	0.5260	.0460	.0440	.0020	1.33	.0050	.0016	1.0140	0.6240	3.69	2.72	7.92	14
3.60	3.60	0.00	0.3760	.0720	.0480	.0240	1.44	.0150	.0015	1.1700	1.0920	3.53	2.50	7.92	15
3.80	1.60	2.20	0.1540	.0420	.0220	.0200	1.47	.0030	.0004	1.4040	1.2320	4.36	2.02	10.98	16
3.20	1.80	1.40	0.2140	.0460	.0320	.0140	1.05	.0080	.0010	1.5990	1.1700	1.97	1.86	4.71	17
8.60	4.40	4.20	0.2640	.1820	.0780	.1040	1.70	.0450	.0166	3.7050	1.5990	3.53	1.92	4.01	18
5.60	2.00	3.60	0.1640	.0520	.0220	.0300	1.18	.0300	.0020	1.2480	0.6864	3.23	1.80	6.35	19
3.20	1.80	1.40	0.1140	.0520	.0320	.0200	1.16	.0020	.0005	1.3260	1.1540	1.74	1.76	4.39	20
1.80	0.80	1.00	0.1160	.0460	.0340	.0120	1.01	.0200	.0001	1.0920	0.7410	1.34	1.52	4.60	21
5.17	4.16	1.01	0.2627	.0678	.0377	.0301	1.23	.0102	.0015	1.5182	1.2094	3.33	2.41	7.91	22

Samples by Days.

4.27	4.13	0.13	.1813	.0453	.0293	.0160	0.62	.0110	.0004	1.1242	0.9497	3.53	1.65	6.33	23
4.00	3.27	0.73	.1587	.0740	.0240	.0500	0.89	.0090	.0010	1.5340	1.3130	3.64	1.65	6.80	24
8.93	8.53	0.40	.1673	.0513	.0227	.0287	0.72	.0023	.0008	1.8200	1.6562	3.76	2.11	10.85	25
5.73	5.00	0.73	.5320	.1127	.0753	.0373	2.50	.0033	.0003	1.6510	1.5340	3.34	5.35	11.82	26
4.53	4.07	0.47	.4573	.0513	.0393	.0120	1.33	.0100	.0011	1.0400	0.8190	3.65	2.50	7.89	27
5.20	2.60	2.60	.2107	.0900	.0440	.0460	1.41	.0187	.0060	2.2360	1.3337	3.29	1.93	6.57	28
3.53	1.53	2.00	.1313	.0500	.0293	.0207	1.12	.0173	.0009	1.2220	0.8605	2.10	1.69	5.11	29
5.17	4.16	1.01	.2627	.0678	.0377	.0301	1.23	.0102	.0015	1.5182	1.2094	3.33	2.41	7.91	30

at Corresponding Hours.

4.00	2.74	1.26	.2383	.0440	.0240	.0200	1.03	.0116	.0008	1.3406	1.0324	3.75	2.05	8.12	31
5.74	5.03	0.71	.2140	.0449	.0269	.0180	0.93	.0038	.0008	1.4829	1.2825	3.34	1.85	7.80	32
5.77	4.71	1.06	.3357	.1146	.0623	.0523	1.72	.0153	.0029	1.7310	1.3134	2.91	3.34	7.81	33
5.17	4.16	1.01	.2627	.0678	.0377	.0301	1.23	.0102	.0015	1.5182	1.2094	3.33	2.41	7.91	34

built opposite the sludge beds of the Worcester precipitation works, and above the place where the effluent

portions, collected at intervals of about two hours, beginning at 9 A.M.; the second, also of three equal portions, collected at 1 A.M. and 7 A.M.

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone

[Parts per 100,000.]

	Number.	Date of — Collection — 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total Residue. Total.	Residue on Evaporation. Total Residue. Dissolved.	Residue on Evaporation. Total Residue. Suspended.
		September.	Sept.						
1	14974	4, 8 A.M. to 2 P.M.	5	Distinct, rusty.	Heavy, rusty.	.10	35.60	31.20	4.40
2	14984	4, 2 P.M. to 8 P.M.	5	Decided, rusty.	Heavy, rusty.	.10	37.40	34.20	3.20
3	14993	4-5, 8 P.M. to 8 A.M.	5	Decided, milky.	Cons., rusty.	.20	38.40	36.00	2.40
4	15009	5, 8 A.M. to 2 P.M.	6	Decided, milky.	Heavy, rusty.	.15	35.80	32.00	3.80
5	15013	5, 2 P.M. to 8 P.M.	6	Distinct.	Heavy, rusty.	.50	42.80	37.40	5.40
6	15020	5-6, 8 P.M. to 8 A.M.	6	V. dec'd, milky.	Slight, rusty.	.20	39.60	38.00	1.60
7	15026	6, 8 A.M. to 2 P.M.	7	Distinct, milky.	Cons., rusty.	.50	33.60	32.40	1.20
8	15033	6, 2 P.M. to 8 P.M.	7	Decided, milky.	Cons., rusty.	.30	48.80	41.40	7.40
9	15039	6-7, 8 P.M. to 8 A.M.	7	Decided, milky.	Slight, rusty.	.50	46.00	42.80	3.20
10	15059	7, 8 A.M. to 2 P.M.	8	Decided, milky.	Cons., brown.	.30	43.60	40.40	3.20
11	15060	7, 2 P.M. to 8 P.M.	8	Distinct, milky.	Cons., rusty.	.20	46.00	41.00	5.00
12	15069	7-8, 8 P.M. to 8 A.M.	8	Distinct, rusty.	Cons., rusty.	.40	19.20	17.00	2.20
13	15070	8, 8 A.M. to 2 P.M.	8	Decided, milky.	Cons., rusty.	.35	43.80	42.60	1.20
14	15077	8, 2 P.M. to 8 P.M.	9	Distinct, milky.	Cons., rusty.	.35	45.80	44.40	1.40
15	15093	8-9, 8 P.M. to 8 A.M.	9	Decided, milky.	Cons., brown.	.70	38.80	34.80	4.00
16	15103	9, 8 A.M. to 2 P.M.	10	Distinct, milky.	Cons., brown.	.12	34.00	28.60	5.40
17	15117	9, 2 P.M. to 8 P.M.	10	Decided, milky.	Cons., rusty.	.23	36.20	33.40	2.80
18	15123	9-10, 8 P.M. to 8 A.M.	10	Thick, muddy.	Cons., dark.	.90	51.00	32.00	19.00
19	15145	10, 8 A.M. to 2 P.M.	11	Distinct, milky.	Cons., brown.	.18	32.20	27.80	4.40
20	15147	10, 2 P.M. to 8 P.M.	11	Distinct, milky.	Heavy, rusty.	.30	40.00	38.20	1.80
21	15155	10-11, 8 P.M. to 8 A.M.	11	Decided, milky.	Cons., brown.	.30	39.00	36.00	3.00
22	Av.	....	.....	....	....	.33	39.41	35.31	4.10

Averages of the above

		Color.	Total.	Dissolved.	Suspended.
23	For the 24 hours beginning at 8 A.M., Wednesday, Sept. 4, ...	.13	37.13	33.80	3.33
24	For the 24 hours beginning at 8 A.M., Thursday, Sept. 5, ...	.28	39.40	35.80	3.60
25	For the 24 hours beginning at 8 A.M., Friday, Sept. 6, ...	.43	42.80	38.87	3.93
26	For the 24 hours beginning at 8 A.M., Saturday, Sept. 7, ...	.30	36.27	32.80	3.47
27	For the 24 hours beginning at 8 A.M., Sunday, Sept. 8, ...	.47	42.80	40.60	2.20
28	For the 24 hours beginning at 8 A.M., Monday, Sept. 9, ...	.42	40.40	31.33	9.07
29	For the 24 hours beginning at 8 A.M., Tuesday, Sept. 10, ...	.26	37.07	34.00	3.07
30	Average, ...	.33	39.41	35.31	4.10

Averages of Samples collected at

		Color.	Total.	Dissolved.	Suspended.
31	For the hours from 8 A.M. to 2 P.M., ...	.24	36.94	33.57	3.37
32	For the hours from 2 P.M. to 8 P.M., ...	.28	42.43	38.57	3.86
33	For the hours from 8 P.M. to 8 A.M., ...	.46	38.86	33.80	5.06
34	Average, ...	.33	39.41	35.31	4.10

Odor, offensive. —— The samples were collected from the river, about one thousand feet below the the same manner as those above the precipitation works, but about half an hour later in each case.

River, below the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Residue on Evaporation — Con. Loss on Ignition. Total.	Residue on Evaporation — Con. Loss on Ignition. Dissolved.	Residue on Evaporation — Con. Loss on Ignition. Suspended.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed. Unfiltered.	Oxygen Consumed. Filtered.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
6.00	5.20	0.80	0.5240	.1960	.1700	.0260	2.95	.0000	.0000	1.4014	1.2705	1.52	8.22	11.50	1
9.80	9.80	0.00	0.5740	.1640	.1220	.0420	3.55	.0150	.0036	1.6555	1.3475	1.95	8.14	11.85	2
8.00	8.00	0.00	0.5860	.1980	.1640	.0340	3.50	.0200	.0048	1.5554	1.2320	1.40	8.52	11.08	3
6.80	5.80	1.00	0.4680	.2540	.2120	.0420	2.75	.0020	.0002	1.7160	1.7160	2.04	8.22	11.25	4
8.00	6.80	1.20	0.5680	.1360	.1020	.0340	3.45	.0300	.0115	2.0280	2.0280	3.86	8.28	12.76	5
8.20	8.00	0.20	0.6020	.1860	.1500	.0360	4.15	.0100	.0200	1.8720	1.7160	1.62	9.58	12.99	6
9.00	9.00	0.00	0.5720	.2940	.1680	.1260	2.70	.0000	.0028	1.7550	1.7316	1.76	7.18	11.46	7
9.40	7.40	2.00	0.7140	.1300	.1040	.0260	3.90	.0200	.0140	1.9500	1.6770	3.83	9.36	15.37	8
10.60	9.40	1.20	0.7060	.1100	.1080	.0020	4.00	.0100	.0380	2.1060	2.0280	2.21	10.04	15.12	9
11.00	9.60	1.40	0.6280	.5720	.4660	.1060	2.90	.0040	.0000	1.9500	1.6770	2.89	8.96	15.31	10
8.00	7.20	0.80	0.7580	.1600	.1180	.0420	3.55	.0150	.0080	2.1060	1.8720	1.29	10.42	15.89	11
4.60	4.40	0.20	0.3300	.0400	.0220	.0180	1.06	.0120	.0002	0.8580	0.7800	2.87	1.92	6.71	12
8.80	8.20	0.60	1.6100	.5060	.4620	.0440	4.50	.0000	.0000	2.1450	1.9890	0.50	10.08	13.03	13
9.60	7.80	1.80	2.2060	.2000	.1780	.0220	5.20	.0020	.0700	1.4430	1.3650	0.57	9.54	12.10	14
5.20	4.80	0.40	1.5240	.1720	.1540	.0180	4.70	.0000	.0320	1.7550	1.5210	1.16	7.26	9.44	15
7.00	4.80	2.20	0.7540	.2020	.1580	.0440	3.20	.0100	.0000	1.7160	1.3104	3.72	5.02	9.96	16
7.80	7.80	0.00	0.7740	.1580	.1040	.0540	3.60	.0080	.0100	2.1450	1.9890	2.00	6.66	10.37	17
9.60	5.80	3.80	0.6240	.2280	.1340	.0940	3.20	.0050	.0001	2.5350	1.6380	2.37	7.16	8.02	18
8.00	6.00	2.00	0.3440	.1820	.1240	.0580	2.80	.0000	.0000	1.7550	1.4430	1.73	6.46	10.15	19
8.40	7.80	0.60	0.5040	.1740	.1240	.0500	3.85	.0180	.0063	2.4570	1.7940	2.21	7.08	12.34	20
7.80	6.00	1.80	0.5360	.2080	.1640	.0440	4.40	.0000	.0000	1.7940	1.7160	1.57	7.82	11.15	21
8.17	7.12	1.05	0.7574	.2128	.1670	.0458	3.52	.0086	.0105	1.8428	1.6115	2.05	7.90	11.80	22

Samples by Days.

7.93	7.67	0.26	0.5613	.1860	.1520	.0340	3.33	.0117	.0028	1.5374	1.2833	1.62	8.29	11.48	23
7.67	6.87	0.80	0.5460	.1920	.1547	.0373	3.45	.0140	.0106	1.8720	1.8200	2.51	8.69	12.33	24
9.67	8.60	1.07	0.6640	.1780	.1267	.0513	3.53	.0100	.0183	1.9370	1.8122	2.60	8.86	13.98	25
7.87	7.07	0.80	0.5720	.2573	.2020	.0553	2.50	.0103	.0027	1.6380	1.4430	2.35	7.10	12.64	26
7.87	6.93	0.94	1.7800	.2927	.2647	.0280	4.80	.0007	.0340	1.7810	1.6250	0.74	8.96	11.52	27
8.13	6.13	2.00	0.7173	.1960	.1320	.0640	3.33	.0077	.0034	2.1320	1.6458	2.70	6.28	9.45	28
8.07	6.60	1.47	0.4613	.1880	.1373	.0507	3.68	.0060	.0021	2.0020	1.6510	1.84	7.12	11.21	29
8.17	7.12	1.05	0.7574	.2128	.1670	.0458	3.52	.0086	.0105	1.8428	1.6115	2.05	7.90	11.80	30

Corresponding Hours during the Week.

8.09	6.94	1.15	.7000	.3151	.2514	.0637	3.11	.0023	.0004	1.7769	1.5911	2.02	7.73	11.81	31
8.71	7.80	0.91	.8711	.1603	.1217	.0386	3.87	.0154	.0176	1.9692	1.7246	2.24	8.50	12.95	32
7.71	6.63	1.08	.7011	.1631	.1280	.0351	3.57	.0081	.0136	1.7822	1.5187	1.89	7.47	10.64	33
8.17	7.12	1.05	.7574	.2128	.1670	.0458	3.52	.0086	.0105	1.8428	1.6115	2.05	7.90	11.80	34

point where the effluent from the precipitation works enters the stream. The samples were collected in

BLACKSTONE RIVER.

Chemical Examination of Water from Singletary,

[Parts per 100,000.]

	Number.	Date of — Collection, 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total. Total.	Residue on Evaporation. Total. Dissolved.	Residue on Evaporation. Total. Sus-pended.	Loss on Ignition. Total.	Loss on Ignition. Dissolved.	Loss on Ignition. Sus-pended.
		Sept.	Sept.									
1	15041	6	7	Dec'd, milky.	Slight, dark.	.40	4.40	3.60	0.80	2.00	1.80	0.20
2	15098	7	9	Dec'd, purple.	Cons , purple.	.30	9.00	8.60	0.40	3.00	2.80	0.20
3	15042	6	7	Slight.	Slight.	.40	5.80	5.70	0.10	1.80	1.70	0.10
4	15097	7	9	Slight.	Slight.	.40	5.70	5.70	0.00	1.70	1.70	0.00
5	15043	6	7	Distinct.	Slight, dark.	.40	6.20	-	-	2.00	-	-

Odor, of the first sample, disagreeable; of the second, distinct; of the last three, vegetable. —— The from Dorothy Brook, above the highway bridge near its mouth; the last one, from Coldspring Brook, at four equal portions, collected at intervals of three hours, as follows: No. 15041 at 7 45 and 10.45 A M , and A.M., and 2.38 and 5.35 P.M.; No. 15097, at 8.40 and 11.38 A.M., and 2 40 and 5.40 P.M.

Chemical Examination of Water from the Blackstone

[Parts per 100,000.]

	Number.	Date of — Collection, 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total. Total.	Residue on Evaporation. Total. Dissolved	Residue on Evaporation. Total. Sus-pended.	Loss on Ignition. Total.	Loss on Ignition. Dissolved.	Loss on Ignition. Sus-pended.
		Sept.	Sept.									
1	15040	6	7	Dec'd, milky.	Slight, rusty.	.70	36.20	35.20	1.00	5.80	5.60	0.20
2	15096	7	9	Dec'd, rusty.	Cons., rusty.	.90	37.80	34.60	3.20	3.60	3.40	0.20
3	15046	6	7	Distinct, milky	Slight, rusty.	.30	27.20	25.60	1.60	6.60	6.40	0.20
4	15095	7	9	Distinct, milky.	Cons., brown.	.25	30.00	25.80	4.20	4.60	3.80	0.80

Odor, offensive. —— The first two samples were collected from the river at the outlet of Morse's Millbury. Each sample was made up of four equal portions, collected at intervals of three hours, as and 11.20 A.M., and 2.20 and 5.20 P M.

Chemical Examination of Water from the

[Parts per 100,000.]

	Number.	Date of — Collection, 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total. Total.	Residue on Evaporation. Total. Dissolved.	Residue on Evaporation. Total. Sus-pended.	Loss on Ignition. Total.	Loss on Ignition. Dissolved.	Loss on Ignition. Sus-pended.
		Sept.	Sept.									
1	15045	6	7	Distinct, milky.	Slight, rusty.	.38	18.60	18.00	0.60	4.00	3.80	0.20
2	15094	7	9	Distinct, milky.	Slight, rusty.	.25	26.80	24.60	2.20	4.60	4.20	0.40
3	Av..	......	......	....	....	.32	22.70	21.30	1.40	4.30	4.00	0.30

Odor, musty. —— The samples were collected from the river, at the bridge on the road from Saun- was made up of four equal portions, collected at 9 A.M., 12 M , 3 P.M. and 6 P.M.

BLACKSTONE RIVER.

Dorothy and Cold Spring Brooks, at Millbury.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.					
	Albuminoid.											
Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
.0140	.0360	.0280	.0080	.37	.0000	.0006	1.2870	1.2480	.07	.71	.70	1
.0016	.0580	.0360	.0220	.43	.0000	.0001	1.5600	1.5210	.14	.55	.97	2
.0006	.0264	.0204	.0060	.35	.0000	.0002	0.5694	-	.09	.68	.54	3
.0024	·0282	.0248	.0034	.33	.0000	.0001	0.5577	-	.06	.69	.52	4
.0324	.0224	.0188	.0036	.31	.0100	.0005	0.4820	-	.13	.61	.25	5

first two samples were collected from Singletary Brook, about 100 feet above its mouth; the next two, the highway bridge not far from its mouth, at 8.10 A.M. Each sample, except the last, was made up of 2.00 and 4.55 P.M.; No. 15098, at 8.00 and 10.58 A.M., and 1.58 and 5.00 P.M.; No. 15042, at 8.40 and 11.40

River above and below Millbury.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.					
	Albuminoid.											
Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
0.7800	.1160	.0840	.0320	3.63	.0000	.0003	1.5750	1.5600	1.28	8.82	12.63	1
1.0620	.0920	.0670	.0250	3.59	.0000	.0002	1.5990	1.1700	1.43	9.00	13.61	2
0.7400	.0800	.0520	.0280	2.74	.0000	.0200	1.1700	1.1700	0.43	6.46	8.57	3
0.6100	.0680	.0510	.0170	2.90	.0000	.0005	1.3650	1.1310	0.32	6.84	10.04	4

mill-pond in Millbury; the last two samples, from the river about half a mile below the last dam in follows: the first two samples, at 8.55 and 11.50 A.M., and 2.55 and 5.55 P.M.; the last two samples, at 8.20

Blackstone River, at Farnumsville.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.					
	Albuminoid.											
Free.	Total.	Dissolved.	Sus-pended	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
.6360	.0460	.0400	.0060	2.47	.0020	.0012	1.2870	1.1700	.02	5.38	7.22	1
.5940	.0490	.0400	.0090	2.43	.0050	.0150	1.0530	0.9360	.16	5.70	8.41	2
.6150	.0475	.0400	.0075	2.45	.0035	.0081	1.1700	1.0530	.09	5.54	7.82	3

dersville to Grafton, above the confluence of the Blackstone and Quinsigamond rivers. Each sample

BLACKSTONE RIVER.

Chemical Examination of Water from the

[Parts per 100,000.]

	Number.	Date of— Collection, 1895.	Examination, 1895.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation. Total. Total.	Total. Dissolved.	Total. Suspended.	Loss on Ignition. Total.	Loss on Ignition. Dissolved.	Loss on Ignition. Suspended.
1	15044	Sept. 6	Sept. 7	Very slight.	Very slight.	.35	4.50	-	-	1.50	-	-
2	15099	7	9	Very slight.	Slight.	.33	5.20	4.90	0.30	1.60	1.40	0.20
3	Av.	......	......	....	....	.34	4.85	-	-	1.55	-	-

Odor, vegetable.—— The samples were collected from the Quinsigamond River, at the bridge on the sample was made up of four equal portions, collected at 9 A.M., 12 M., 3 P.M. and 6 P.M.

Chemical Examination of Water from

[Parts per 100,000.]

	Number.	Date of— Collection, 1895.	Examination, 1895.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation. Total.	Loss on Ignition.
1	14976	Sept. 4	Sept. 5	Slight.	Slight.	.18	14.50	4.20
2	15002	5	6	Distinct.	Slight, rusty.	.20	15.30	2.90
3	15027	6	7	Slight.	Slight.	.20	15.70	3.60
4	15078	7	9	Slight.	Slight, brown.	.18	16.90	3.50
5	15082	7	9	Slight.	Slight.	.18	17.30	3.80
6	15124	9	10	Slight.	Slight.	.15	17.40	3.40
7	15149	10	11	Slight.	Slight, brown.	.20	18.40	4.50
8	Av.	....	....	....	....	.18	16.50	3.70

Odor, vegetable or musty.——The samples were collected from the lower end of the canal leading one being collected at about 9 A.M., and one at about 3 P.M.

BLACKSTONE RIVER.

Quinsigamond River, at Farnumsville.

[Parts per 100,000.]

Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Iron Oxide (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
.0004	.0238	.0224	.0014	.35	.0040	.0002	.4602	.02	.71	.35	1
.0020	.0226	.0196	.0030	.36	.0000	.0001	.4313	.03	.67	.39	2
.0012	.0232	.0210	.0022	.36	.0020	.0002	.4458	.03	.69	.37	3

road from Saundersville to Grafton, about a mile above its confluence with the Blackstone River. Each

the Blackstone River, at Uxbridge.

[Parts per 100,000]

Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Iron (Fe_2O_3).	Lime (Ca. O.).	Sulphuric Acid (SO_3).	
.0445	.0185	.0145	.0040	1.58	.1000	.0055	.3249	-	-	-	1
.0816	.0260	.0204	.0056	1.71	.0850	.0100	.3681	-	-	-	2
.1120	.0244	.0184	.0060	1.76	.0700	.0100	.3884	-	-	-	3
.0996	.0268	.0216	.0052	1.87	.0600	.0080	.3432	-	-	-	4
.1028	.0224	.0184	.0040	1.78	.0600	.0060	.3660	-	-	-	5
.1184	.0196	.0152	.0044	1.78	.0850	.0055	.3744	-	-	-	6
.1040	.0184	.0180	.0004	1.80	.0650	.0000	.3884	-	-	-	7
.0947	.0223	.0181	.0042	1.75	.0750	.0064	.3648	.07*	3.44*	4.07*	8

from the upper dam of the Calumet Woolen Company. Each sample was made up of two equal portions,

* These determinations were made upon a mixture of equal parts of water from each of the samples.

BLACKSTONE RIVER.

Chemical Examination of Water from

[Parts per 100,000.]

	Number.	Date of— Collection, 1895.	Date of— Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.
1	15004	Sept. 5	Sept. 6	Distinct.	Slight, yellow.	.45	2.80	0.60
2	15080	7	9	Distinct.	Cons., brown.	.43	3.85	1.15
3	Av.....	....	....	....	....	.44	3.33	0.88

Odor, musty. —— The samples were collected from the Mumford River, at a point near the iron the confluence of the Mumford and Blackstone rivers. The samples were collected at about 3 P. M.

Chemical Examination of Water from

[Parts per 100,000.]

	Number.	Date of— Collection, 1895.	Date of— Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.
1	15003	Sept. 5	Sept. 6	Distinct.	Slight.	.40	4.20	1.60
2	15081	7	9	Distinct.	Slight.	.40	4.50	1.65
3	Av.....	....	....	....	....	.40	4.35	1.63

Odor, vegetable and musty.— The samples were collected from the West River, below the last

the Mumford River, at Uxbridge.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
	Albuminoid.										
Free.	Total.	Dissolved	Sus-pended.		Nitrates.	Nitrites.					
.0004	.0220	.0158	.0062	.33	.0000	.0002	.3861	.11	.36	.28	1
.0024	.0214	.0178	.0036	.33	.0000	.0001	.3627	.24	.69	.22	2
.0014	.0217	.0168	.0049	.33	.0000	.0002	.3744	.18	.53	.25	3

bridge, on the road to the freight depot, just below Capron's Mill, and about three-eighths of a mile above

the West River, at Uxbridge.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron (Fe_2O_3).	Lime (Ca O).	Sulphuric Acid (SO_3).	
	Albuminoid.										
Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.					
.0030	.0234	.0226	.0008	.34	.0000	.0003	.5319	.10	.51	.20	1
.0028	.0290	.0246	.0044	.34	.0000	.0004	.5382	.16	.97	.18	2
.0029	.0262	.0236	.0026	.34	.0000	.0004	.5351	.13	.74	.19	3

bridge on the stream, which is a little less than half a mile above its mouth, at about 3.30 P.M.

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River, at Millville, Blackstone.

[Parts per 100,000.]

Number.	Date of — Collection, 1895.	Date of — Examination, 1895.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.
14975	Sept. 4	Sept. 5	Slight.	Slight.	.20	9.70	2.40
15001	5	6	Slight.	Slight.	.22	10.40	2.50
15028	6	7	Very slight.	Slight.	.25	11.50	2.50
15079	7	9	Slight.	Cons., brown.	.25	11.30	2.30
15104	9	10	Slight.	Slight.	.35	10.60	1.80
15148	10	11	Distinct.	Slight.	.20	11.40	3.60
15157	11	12	Slight.	Slight.	.25	10.60	2.50
Av.					.25	10.79	2.51

Chemical Examination of Water from the Blackstone River, at Millville, Blackstone — Concluded.

[Parts per 100,000.]

Number.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Iron (Fe_2O_3).	Lime (CaO).	Sulphuric Acid (SO_3).
14975	.0174	.0210	.0194	.0016	1.10	.0600	.0013	.3064	-	-	-
15001	.0164	.0230	.0180	.0050	1.10	.0180	.0018	.3822	-	-	-
15028	.0170	.0192	.0192	.0000	1.02	.0480	.0020	.4095	-	-	-
15079	.0426	.0228	.0196	.0032	1.18	.0520	.0020	.3572	-	-	-
15104	.0380	.0188	.0166	.0022	1.13	.0400	.0020	.3962	-	-	-
15148	.0380	.0208	.0164	.0044	1.26	.0500	.0018	.3822	-	-	-
15157	.0394	.0180	.0154	.0026	1.10	.0300	.0015	.3884	-	-	-
Av.	.0298	.0205	.0178	.0027	1.13	.0426	.0018	.3746	*.08	*2.06	*2.41

* These determinations were made upon a mixture of equal parts of water from all the samples.

Odor, musty. —— The samples were collected from the river, just above the bridge, in the village of Millville. Each sample was made up of two equal portions, one being collected at 9 A.M., and one at 3 P.M.

Charles River.

Chemical Examination of Water from the Charles River at Milford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
15684	Dec. 4	V. slight.	Slight.	.80	3.10	1.80	.0000	.0156	.0140	.0016	.20	.0050	.0000	.7114	0.8
15683	Dec. 4	Decided.	Cons., earthy.	.85	5.45	2.35	.0390	.0314	.0258	.0056	.49	.0470	.0014	.7691	1.7

Odor of the first sample, faintly vegetable; of the last, distinctly vegetable and musty. — The first sample was collected at the dam opposite the pumping station of the Milford Water Company; the last, at the railroad bridge half a mile below Milford.

The samples were collected in connection with an investigation of the pollution of the stream by sewage from Milford.

Crane's River.

Chemical Examination of Water from Crane's River, Danvers.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.
	1895.					
15530	Nov. 12	V. slight.	Slight.	0.50	7.60	2.70
15532	Nov. 12	Decided.	Cons., brown.	10.00	27.80	9.80
15533	Nov. 12	Decided.	Slight.	2.50	40.90	9.00
15520	Nov. 12	Slight.	Slight.	0.50	3347.00	-
15534	Nov. 12	Decided.	Slight.	2.40	85.80	22.40
15519	Nov. 12	Slight, white.	Slight, earthy.	0.13	3349.00	-
15535	Nov. 12	Distinct, brown.	Slight, earthy.	0.40	2892.00	-

Chemical Examination of Water from Crane's River, Danvers — Concluded.

[Parts per 100,000.]

Number.	Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
	Free.	Albuminoid.				Nitrates.	Nitrites.		
		Total.	Dissolved.	Suspended.					
15530	.0000	.0218	.0208	.0010	0.98	.0200	.0000	0.6357	2.7
15532	.0720	.1480	.1140	.0340	57.50	.0250	.0008	4.6800	6.0
15533	.0410	.0720	.0520	.0200	15.95	.0250	.0060	1.7160	9.0
15520	.0316	.0236	.0184	.0052	1245.00	.0030	.0025	2.4024	-
15534	.0470	.0720	.0490	.0230	38.50	.0130	.0060	1.7550	19.0
15519	.0204	.0176	.0096	.0080	1610.00	.0050	.0020	3.2370	-
15535	.0308	.0280	.0228	.0052	1295.00	.0020	.0030	2.4960	-

Odor of the first sample, none, becoming distinctly vegetable on heating; of the second, disagreeable; of the third and fifth, distinct of manufacturing waste; of the fourth and sixth, faintly musty; of the last, unpleasant. — The samples were collected as follows: No. 15530 from Crane's Brook at the point where it is crossed by the railroad at Tapleyville and above factories in Danvers; No. 15532 from Crane's Brook about 1,000 feet below tannery; No 15533 from Crane's Pond at the railroad bridge near the lower end; Nos. 15520 and 15534 from Crane's River just below dam at tide mill, the first when the tide was half out and the last at low tide; Nos. 15519 and 15535 from the Essex Branch River below Danversport, the first when the tide was half out and the last at low tide.

These samples were collected in connection with an investigation of the pollution of the stream by manufacturing refuse.

CRANE'S RIVER.

Chemical Examination of Manufacturing Sewage from Morocco Shops in Danvers.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.		Residue on Evaporation.					
				Total Residue.			Loss on Ignition.		
		Turbidity.	Sediment.	Total.	Dissolved	Sus-pended.	Total.	Dissolved.	Sus-pended.
15531	1895. Nov. 12	Opaque.	Dark, brown.	445.0	354.2	90.8	190.6	113.6	77.0

Chemical Examination of Manufacturing Sewage from Morocco Shops in Danvers — Concluded.

[Parts per 100,000.]

Number.	Ammonia.				Chlorine.	Oxygen Consumed.		Iron.	
		Albuminoid.							
	Free.	Total.	Dissolved.	Sus-pended.		Unfiltered.	Filtered.	Unfiltered.	Filtered.
15331	1.3600	4.3400	2.2200	2.1200	102.5	141.96	79.56	.5100	.1800

Odor, offensive. —— The sample was collected from a drain discharging sewage from three morocco shops into Crane's River.

This analysis was made in connection with an investigation of the pollution of the stream by manufacturing sewage.

Deerfield River.

Chemical Examination of Water from the Deerfield River above Shelburne Falls.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13673	Jan. 14	V. slight.	V. slight.	.25	2.90	0.95	.0002	.0088	.0074	.0014	.10	.0120	.0000	.3397	1.6
13751	Feb. 4	V. slight.	V. slight.	.20	3.50	0.85	.0012	.0082	.0070	.0012	.12	.0180	.0000	.2528	1.8
13987	Mar. 15	V. slight.	Slight.	.15	3.35	0.70	.0004	.0062	.0046	.0016	.12	.0120	.0000	.2275	2.2
14075	Apr. 1	V. slight.	Cons., white.	.12	3.75	1.10	.0002	.0056	.0042	.0014	.10	.0270	.0000	.1848	1.8
14232	May 1	V slight.	Slight.	.32	2.95	1.45	.0000	.0112	.0084	.0028	.08	.0080	.0001	.4504	1.1
14420	June 3	Slight.	Slight, rusty.	.17	4.20	1.20	.0046	.0166	.0146	.0020	.16	.0030	.0000	.3230	1.9
14575	July 2	Slight.	Slight.	.33	3.45	0.95	.0010	.0178	.0146	.0032	.08	.0000	.0001	.5348	1.9
14768	Aug. 5	V. slight.	Slight.	.80	4.20	1.70	.0006	.0188	.0172	.0016	.08	.0120	.0001	.9633	1.9
14964	Sept. 3	V slight.	V. slight.	.28	4.20	1.00	.0002	.0118	.0080	.0038	.14	.0000	.0001	.4196	1.8
15295	Oct. 1	Slight.	Slight.	.40	4.10	1.70	.0008	.0148	.0136	.0012	.14	.0030	.0000	.5288	1.7
15482	Nov. 5	V. slight.	Slight.	.40	3.60	1.30	.0004	.0118	.0088	.0030	.10	.0140	.0001	.5834	1.4
15682	Dec. 3	Distinct.	Cons.	.40	2.95	1.15	.0000	.0128	.0088	.0040	.04	.0070	.0000	.5733	0.9
Av.	....	....	....	.32	3.60	1.17	.0008	.0120	.0097	.0023	.10	.0097	.0000	.4484	1.7

Odor, faintly vegetable or none. —— The samples were collected from the river about a mile above the bridge in the village of Shelburne Falls.

French River.

Chemical Examination of Water from French River and its Tributaries in Webster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
15604	Nov. 22	Slight.	Slight.	.97	4.20	2.05	.0006	.0194	.0166	.0028	.21	.0070	.0001	0.9009	0.8
15603	Nov. 22	Distinct.	Slight.	.30	6.70	2.45	.0010	.0224	.0164	.0060	.27	.0030	.0000	0.6318	2.3
15602	Nov. 22	Distinct.	Slight.	.60	6.95	2.70	.0010	.0520	.0424	.0096	.70	.0030	.0001	0.9298	1.7
15605	Nov. 22	Decided.	Slight.	.95	5.25	2.40	.0096	.0324	.0266	.0058	.31	.0070	.0002	1.0374	1.1

Odor of the first sample, distinctly vegetable; of the second, distinctly vegetable and disagreeable; of the third, distinctly tarry; of the last, decidedly tarry. —— The first sample was collected from French River above Webster, just above the mouth of Mill Brook; the second, from Mill Brook, near its confluence with French River; the third, from a brook entering French River just below Merino Village in Dudley; the last, from French River at the first railroad bridge over the river below the line between Massachusetts and Connecticut.

These samples were collected in connection with an investigation relative to a proposed system of sewerage and sewage disposal for the town of Webster.

HOOSAC RIVER.

Hoosac River.

Chemical Examination of Water from the Hoosac River at Williamstown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13591	Jan. 2	Distinct, clayey.	Slight, earthy.	.30	12.30	2.90	.0190	.0248	.0208	.0040	0.35	.0220	.0004	.4158	8.6
13674	Jan. 15	Distinct, milky.	Slight, white.	.20	8.00	1.60	.0086	.0192	.0140	.0052	0.25	.0300	.0001	.2528	6.1
13848	Feb. 19	Distinct.	Slight, gray.	.20	13.50	2.90	.0194	.0272	.0220	.0052	0.49	.0230	.0009	.5460	8.6
14022	Mar. 20	Distinct, milky.	Cons., gray.	.25	11.40	2.60	.0146	.0226	.0186	.0040	0.33	.0100	.0007	.4740	7.6
14160	Apr. 16	Distinct, milky.	Cons.	.20	6.40	3.15	.0020	.0252	.0158	.0094	0.18	.0350	.0003	.4898	2.9
14356	May 21	Distinct.	Cons.	.20	11.65	2.80	.0002	.0264	.0158	.0106	0.34	.0150	.0010	.3078	8.4
14519	June 20	Distinct.	Cons., rusty.	.28	14.00	4.00	.0086	.0192	.0104	.0088	0.52	.0080	.0042	.4158	9.4
14716	July 24	Distinct.	Cons., dark.	.30	17.70	1.90	.0464	.0676	.0344	.0332	0.86	.0050	.0011	.4889	12.6
14895	Aug. 20	Distinct.	Heavy, dirty.	.28	15.55	3.65	.0140	.0576	.0216	.0360	0.74	.0050	.0020	.5382	9.7
15196	Sept. 17	Slight, milky.	Cons., rusty.	.35	18.25	3.50	.0342	0454	.0338	.0116	1.00	.0030	.0030	.5382	10.7
15389	Oct. 15	Distinct, milky.	Slight, rusty.	.60	11.30	3.60	.0016	.0352	.0254	.0098	0.34	.0180	.0012	.8330	6.4
15588	Nov. 19	Slight.	Cons.	.25	8.40	2.90	.0090	.0296	.0190	.0106	0.32	.0150	.0003	.3432	5.4
15763	Dec. 17	Distinct, milky.	Slight.	.18	10.65	2.10	.0112	.0234	.0142	.0092	0.28	.0320	.0005	.2618	7.7
Av.*	....	....	....	.28	12.41	2.95	.0146	.0334	.0207	.0127	0.39	.0162	.0013	.4642	8.1

Averages by Years.

-	1887†	-	-	.21	11.50	1.23	.0057	.0178	-	-	.22	.0239	-	-	-
-	1888	-	-	.10	10.21	1.65	.0040	.0187	.0143	.0044	.24	.0306	.0010	-	-
-	1889‡	-	-	.08	8.74	1.18	.0071	.0162	.0104	.0058	.18	.0254	.0006	-	-
-	1894	-	-	.23	10.77	2.13	.0111	.0265	.0169	.0096	.35	.0157	.0009	.3421	7.3
-	1895	-	-	.28	12.41	2.95	.0146	.0334	.0207	.0127	.39	.0162	.0013	.5301	8.1

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† June to December. ‡ January to May.

NOTE to analyses of 1895: Odor, generally decidedly musty, frequently also disagreeable. —— The samples were collected from the river at the bridge near the Williamstown station on the Fitchburg Railroad.

Housatonic River.

Chemical Examination of Water from the Housatonic River at New Lenox.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13703	Jan. 22	Distinct, milky.	Cons., gray.	.10	10.90	1.95	.0114	.0182	.0146	.0036	.23	.0150	.0005	.3381	8.3
13855	Feb. 19	Distinct.	Slight.	.30	12.90	1.80	.0210	.0200	.0158	.0042	.24	.0150	.0009	.3939	8.7
14045	Mar. 26	Distinct, clayey.	Cons., dark.	.25	9.60	2.10	.0082	.0264	.0178	.0086	.17	.0170	.0003	.3965	7.5
14214	Apr. 25	Slight.	Cons.	.23	8.55	2.00	.0002	.0144	.0112	.0032	.12	.0170	.0003	.3311	6.4
14518	June 20	Distinct.	Cons., rusty.	.20	10.85	2.70	.0228	.0250	.0192	.0058	.23	.0050	.0020	.3696	7.9
14653	July 18	Slight.	Cons.	.28	11.40	2.00	.0182	.0234	.0206	.0028	.27	.0080	.0100	.4050	8.6
14937	Aug. 29	Distinct.	Slight, rusty.	.20	13.65	3.55	.0232	.0234	.0182	.0052	.36	.0120	.0110	.3900	9.4
15205	Sept. 17	Distinct.	Slight.	.18	15.40	2.55	.0364	.0232	.0210	.0022	.37	.0250	.0100	.3533	10.3
15378	Oct. 15	Slight.	Cons., fibrous	.63	11.80	3.60	.0132	.0374	.0278	.0096	.30	.0270	.0020	.8775	7.6
15749	Dec. 17	Distinct	Cons.	.27	12.30	2.80	.0280	.0268	.0172	.0096	.25	.0320	.0015	.4235	9.2
Av.	....	....	....	.26	11.73	2.50	.0183	.0238	.0183	.0055	.25	.0173	.0038	.4278	8.4

Averages by Years.

-	1893*	-	-	.30	9.73	2.21	.0058	.0174	.0134	.0040	.16	.0175	.0014	.4180	7.0
-	1894	-	-	.27	11.37	2.13	.0131	.0183	.0144	.0039	.25	.0204	.0024	.3512	8.5
-	1895	-	-	.26	11.73	2.50	.0183	.0238	.0183	.0055	.25	.0173	.0038	.4278	8.4

* March to December.

Note to analyses of 1895: Odor, musty.—The samples were collected from the river.

Merrimack River.

The usual monthly examinations of the water of this river opposite the intakes of the Lowell and the Lawrence Water Works have been continued during 1895, the detailed results of which may be found on pages 204 and 191 of this volume. A comparison of the analyses made at these two places during the year is given in the following table:—

MERRIMACK RIVER.

Table comparing the Analyses above Lowell with those above Lawrence, 1895.

[Parts per 100,000.]

	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Sus-pended.				
Number of determinations compared,	11	11	11	11	11	11	11	11	11	11	11
Mean of analyses above Lowell,	.41	3.84	1.46	.0039	.0187	.0140	.0047	.212	.0066	.0001	1.2
Mean of analyses above Lawrence,	.52	4.36	1.79	.0061	.0250	.0186	.0064	.275	.0071	.0002	1.3
Increase,	.11	0.52	0.33	.0022	.0063	.0046	.0017	.063	.0005	.0001	0.1

In order to compare these results with similar ones obtained in previous years, another table is presented, which contains the increase in impurities as the water passes from a point above Lowell to Lawrence, as given in the last line of the above table, and the corresponding increase in previous years: —

Increase in the Amount of Impurities in the Merrimack River Water, from a Point above Lowell to Lawrence, as determined by the Regular Monthly Examinations of Different Years.

[Parts per 100,000.]

DATE.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Sus-pended.				
Increase, 1887-1889,	0.01	0.23	0.09	.0007	.0027	.0017	.0009	.026	.0003*	.0000	-
Increase, 1890,	0.05	0.62	0.22*	.0016	.0023	.0017	.0006	.028	.0020*	.0000	0.2
Increase, 1891,	0.02*	0.29	0.07	.0021	.0023	.0021	.0002	.035	.0030*	.0000	0.1
Increase, 1892,	0.06	0.48	0.12	.0019	.0037	.0037	.0000	.039	.0013*	.0000	0.0
Increase, 1893,	0.09	0.47	0.30	.0031	.0032	.0021	.0011	.035	.0002*	.0001	0.0
Increase, 1894,	0.02	0.15	0.04	.0028	.0032	.0032	.0000	.049	.0000	.0000	0.1
Increase, 1895,	0.11	0.52	0.33	.0022	.0063	.0046	.0017	.063	.0005	.0001	0.1

* Decrease.

The average flow of the river at Lawrence, for twenty-four hours, during the days on which samples were collected, was for the above periods, respectively, at the rate of 9,145, 9,948, 7,931, 5,433, 8,126, 5,459 and 11,634 cubic feet per second.

MERRIMACK RIVER.

Chemical Examination of Water from the Merrimack River above Lowell, opposite the Intake of the Lowell Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14654	July 22	Distinct.	Cons.	.33	4.40	1.85	.0024	.0202	.0148	.0054	.23	.0080	.0004	.4950	1.4
14655	July 22	Slight.	Cons.	.33	4.30	1.90	.0024	.0196	.0162	.0034	.22	.0080	.0004	.4725	1.4
15244	Sept.24	Slight.	Slight, earthy.	.22	3.80	1.30	.0048	.0178	.0154	.0024	.27	.0070	.0002	.3432	1.1
15245	Sept.24	Slight.	Slight, earthy.	.22	3.80	1.15	.0052	.0206	.0150	.0056	.26	.0160	.0002	.3136	1.1

Odor, vegetable. —— The first and third samples were collected from the north half of the river; the second and last, from the south half.

Chemical Examination of Water from the Merrimack River below Lowell.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14679	July 22	Distinct.	Cons.	.40	4.05	1.55	.0028	.0226	.0166	.0060	.30	.0060	.0004	.4500	1.6
14680	July 22	Distinct.	Cons.	.40	4.65	1.75	.0052	.0236	.0190	.0046	.32	.0070	.0004	.4575	1.9
15248	Sept.24	V. slight.	Slight.	.25	3.90	1.20	.0026	.0240	.0188	.0052	.34	.0050	.0002	.3705	1.4
15249	Sept.24	Slight.	Slight.	.25	4.55	1.40	.0062	.0276	.0188	.0088	.42	.0120	.0003	.3471	1.6

Odor of the first two samples, faintly vegetable and mouldy; of the last two, distinctly vegetable. —— The samples were collected from the river, a short distance below Hunt's Falls. The first and third samples were made up of several equal portions collected at different points in the north half of the river; the second and fourth were made up of several equal portions collected at different points in the south half of the river.

MERRIMACK RIVER.

Chemical Examination of Water from the Merrimack River above Lawrence.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14692	July 23	Slight.	Slight.	.38	4.25	1.55	.0092	.0230	.0176	.0054	.34	.0040	.0003	.4800	1.6
14693	July 23	Slight.	Slight.	.52	4.25	1.80	.0076	.0210	.0176	.0034	.35	.0080	.0003	.4875	1.6
15253	Sept. 25	Distinct.	Slight.	.28	4.50	1.50	.0172	.0248	.0190	.0058	.34	.0070	.0007	.3962	1.4
15254	Sept. 25	Distinct.	Slight.	.28	4.45	1.50	.0176	.0240	.0184	.0056	.35	.0080	.0006	.4228	1.3

Odor, vegetable.—— The samples were collected from the river, nearly opposite the intake of the Lawrence Water Works. The first and third samples were made up of several equal portions collected at different points in the north half of the river; the second and fourth were made up of several equal portions collected at different points in the south half of the river.

Chemical Examination of Water from the Merrimack River below Lawrence.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14690	July 23	Distinct.	Cons., fibrous.	.53	5.10	1.90	.0092	.0352	.0220	.0132	.44	.0040	.0005	.7050	2.1
14691	July 23	Slight.	Cons.	.50	4.65	1.80	.0100	.0320	.0226	.0094	.42	.0080	.0005	.5700	1.8
15255	Sept. 25	Distinct.	Cons.	.30	5.30	1.75	.0126	.0324	.0206	.0118	.39	.0080	.0007	.4929	1.6
15256	Sept 25	Distinct.	Cons.	.30	4.75	1.50	.0152	.0274	.0210	.0064	.39	.0070	.0008	.3884	1.4

Odor of the first and second samples, faintly vegetable and mouldy; of the third and fourth samples, distinctly vegetable.—— The samples were collected from the river, about a mile below the dam at Lawrence. The first and third samples were made up of several equal portions collected at different points in the north half of the river; the second and fourth were made up of several equal portions collected at different points in the south half of the river.

MERRIMACK RIVER.

Chemical Examination of Water from the Merrimack River above Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Suspended		Nitrates.	Nitrites.		
	1895.														
14713	July 22	Decided.	Cons.	.50	5.35	1.80	.0040	.0288	.0202	.0086	.42	.0050	.0004	.7161	1.9
14712	July 22	Decided	Cons.	.50	5.50	1.90	.0042	.0292	.0204	.0088	.43	.0050	.0006	.6237	2.1
15260	Sept 25	Decided.	Cons.	.33	5.85	2.30	.0172	.0480	.0230	.0250	.49	.0070	.0012	.6536	1.6
15261	Sept.25	Decided.	Cons.	.35	6.00	2.35	.0196	.0452	.0270	.0182	.48	.0060	.0012	.6084	1.7

Odor, distinctly vegetable. —— The samples were collected from the river, about a mile above the Boston & Maine Railroad bridge at Haverhill, the first and third samples from the north half of the river, and the second and last from the south half.

Chemical Examination of Water from the Merrimack River below Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14711	July 22	Decided.	Cons.	.50	5.20	1.60	.0094	.0264	.0204	.0060	.39	.0070	.0004	.5813	1.8
14710	July 22	Decided.	Cons.	.50	5.10	1.70	.0104	.0288	.0190	.0098	.40	.0070	.0005	.5929	1.9
15262	Sept.25	Decided.	Slight.	.35	5.45	2.15	.0244	.0298	.0232	.0066	.44	.0100	.0010	.5008	1.6
15263	Sept.25	Distinct.	Slight.	.25	5.25	1.85	.0234	.0264	.0222	.0042	.42	.0150	.0010	.4997	1.7

Odor, distinctly vegetable and unpleasant. —— The samples were collected from the river, just above Hale's Island. The first and third samples were made up of several equal portions collected at different points in the north half of the river; the second and fourth were made up of several equal portions collected at different points in the south half of the river.

NASHUA RIVER.

Chemical Examination of Water from the North Branch of the Nashua River, below Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13675	Jan. 15	Decided, milky.	Cons., gray.	0.48	6.60	2.30	.0188	.0444	.0290	.0154	0.69	.0270	.0002	0.7505	2.1
13849	Feb. 19	Distinct.	Cons., gray.	0.45	8.60	2.60	.0672	.0422	.0354	.0068	0.86	.0150	.0007	0.6201	2.1
14025	Mar. 20	Distinct, milky.	Cons., gray.	0.43	6.25	1.85	.0160	.0258	.0196	.0062	0.53	.0180	.0004	0.6162	1.9
14151	Apr. 16	Distinct, clayey.	Slight.	0.50	3.40	1.70	.0034	.0178	.0152	.0026	0.28	.0180	.0002	0.5767	1.2
14314	May 16	Distinct, milky.	Cons., dirty.	0.53	7.10	3.10	.0150	.0334	.0234	.0100	0.44	.0050	.0003	0.6478	1.7
14489	June 18	Decided.	Cons., brown.	0.70	10.70	2.60	.4992	.0582	.0446	.0136	1.21	.0100	.0016	0.6591	2.7
14667	July 22	Distinct.	Cons., gray.	0.75	11.90	2.50	.1800	.0560	.0410	.0150	1.46	.0050	.0014	0.8325	3.5
14875	Aug. 20	Decided, milky.	Cons., brown.	0.48	9.20	3.15	.0656	.0368	.0284	.0084	1.40	.0080	.0029	0.6162	3.0
15192	Sept. 16	Distinct, milky.	Cons., dirty.	0.65	12.05	3.25	.0560	.0534	.0472	.0062	1.30	.0030	.0019	0.7527	3.4
15394	Oct. 17	Decided.	Cons., fibrous.	1.00	7.60	3.05	.0148	.0536	.0376	.0160	0.71	.0100	.0006	1.1716	1.9
15575	Nov. 19	Decided.	Cons.	0.70	5.10	1.75	.0164	.0380	.0300	.0080	0.38	.0170	.0003	0.8736	1.3
15762	Dec. 17	Decided, milky.	Cons.	0.40	8.65	3.10	.0456	.0480	.0320	.0160	0.72	.0250	.0012	0.7161	1.9
Av.	....	....	....	0.59	8.10	2.58	.0832	.0423	.0319	.0104	0.75	.0134	.0010	0.7361	2.2

Averages by Years.

-	1893	-	-	0.57	7.46	2.16	.0461	.0360	.0257	.0103	0.69	.0118	.0018	0.6927	2.0
-	1894	-	-	0.56	7.39	2.00	.0634	.0346	.0251	.0095	0.75	.0152	.0020	0.5822	1.9
-	1895	-	-	0.59	8.10	2.58	.0832	.0423	.0319	.0104	0.75	.0134	.0010	0.7361	2.2

NOTE to analyses of 1895: Odor, generally musty and disagreeable, sometimes offensive.——The samples were collected from the river about half a mile below the point where water from the tail-race of the Falulah Paper Company enters the stream.

NASHUA RIVER.

Chemical Examination of Water from the North Branch of the Nashua River, just above its Confluence with the South Branch at Lancaster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1895.														
13670	Jan. 15	Decided, milky.	Cons., earthy.	.50	5.70	1.95	.0244	.0264	.0232	.0032	0.56	.0220	.0002	.6241	1.7
13846	Feb. 19	Distinct.	Cons.	.50	7.60	2.10	.0432	.0312	.0214	.0098	0.86	.0180	.0003	.6513	1.8
14002	Mar. 19	Decided.	Heavy, gray.	.42	4.60	1.35	.0198	.0294	.0206	.0088	0.41	.0250	.0003	.6130	1.4
14156	Apr. 16	Distinct, clayey.	Cons.	.53	3.70	1.60	.0034	.0176	.0150	.0026	0.29	.0180	.0002	.6257	1.1
14339	May 21	Decided.	Cons., gray.	.60	5.80	1.65	.0250	.0190	.0170	.0020	0.54	.0100	.0005	.6122	1.6
14517	June 20	Distinct, milky.	Cons., brown.	.55	7.70	2.60	.0880	.0380	.0220	.0160	0.97	.0200	.0055	.5159	2.2
14702	July 24	Distinct.	Cons.	.67	8.60	2.60	.0232	.0240	.0200	.0040	1.12	.0270	.0060	.5467	2.6
14825	Aug. 13	Slight.	Slight.	.35	9.30	2.20	.0136	.0244	.0232	.0012	1.20	.0300	.0042	.5616	3.0
14910	Aug. 26	Slight.	Slight.	.40	9.20	2.30	.0100	.0232	.0188	.0044	1.06	.0350	.0025	.4992	2.2
15109	Sept. 9	Slight.	Slight, brown.	.32	8.25	1.95	.0124	.0238	.0214	.0024	1.22	.0550	.0068	.4836	2.2
15234	Sept. 23	V. sli ht.	Slight.	.30	9.45	2.05	.0044	.0194	.0174	.0020	1.36	.0430	.0014	.4329	2.5
15326	Oct. 8	V. slight.	V. slight.	.30	9.80	2.80	.0400	.0220	.0196	.0024	1.33	.0330	.0016	.4914	2.7
15410	Oct. 23	Distinct.	Cons., grayish.	.75	8.40	2.95	.0392	.0344	.0304	.0040	0.80	.0180	.0007	.8814	2.1
15508	Nov. 11	Distinct, milky.	Slight, brown.	.68	7.30	2.20	.0314	.0370	.0294	.0076	0.65	.0180	.0006	.6848	1.9
15608	Nov. 25	Decided	Cons.	.58	5.05	1.85	.0080	.0188	.0132	.0056	0.37	.0150	.0003	.6123	1.6
15750	Dec. 17	Decided.	Cons., fibrous.	.48	6.45	2.25	.0318	.0352	.0238	.0114	0.54	.0200	.0008	.6237	1.7
Av.*	....	....	....	.51	6.96	2.10	.0282	.0269	.0208	.0061	0.77	.0236	.0019	.5947	1.9

Averages by Years.

-	1888†	-	-	.56	7.47	1.82	.0118	.0287	.0261	.0026	0.72	.0257	.0012	-	-
-	1890‡	-	-	.38	6.77	2.12	.0117	.0326	.0274	.0052	0.62	.0214	.0014	-	2.6
-	1891§	-	-	.46	10.20	2.25	.0365	.0266	.0235	.0031	1.18	.0331	.0012	-	2.8
-	1892‖	-	-	.48	9.75	2.10	.0422	.0274	0237	.0037	1.11	.0450	.0010	-	3.0
-	1894¶	-	-	.51	8.13	1.98	.0312	.0245	.0199	.0046	0.98	.0287	.0010	.4955	2.3
-	1895	-	-	.51	6.96	2.10	.0282	.0269	.0208	.0061	0.77	.0236	.0019	.5947	1.9

* Where more than one sample was collected in a month the average analysis for that month has been used in making the average.

† Four samples on September 17.

‡ Five samples in July and August.

§ August and October.

‖ August, October and November.

¶ July to December.

NOTE to analyses of 1895: Odor, generally musty and sometimes disagreeable; in September, vegetable.——The samples were collected from the river at the railroad bridge, a short distance above its mouth.

NASHUA RIVER.

Chemical Examination of Water from the Quinepoxet River in Holden.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
13593	Jan. 2	Distinct, milky.	Slight.	0.67	5.55	2.10	.0028	.0262	.0238	.0024	.38	.0180	.0001	0.7099	1.4
13755	Feb. 4	Distinct.	Cons., gray.	0.75	5.90	2.20	.0026	.0384	.0338	.0046	.40	.0180	.0000	0.9164	1.4
13929	Mar. 5	Slight.	Cons., earthy.	0.55	4.30	1.45	.0032	.0280	.0202	.0078	.25	.0100	.0000	0.6129	0.9
14077	Apr. 1	Slight.	Slight.	0.60	3.45	1.50	.0004	.0238	.0206	.0032	.17	.0030	.0000	0.5914	0.5
14235	May 1	Slight.	Cons.	0.68	3.05	1.70	.0000	.0194	.0172	.0022	.18	.0020	.0001	0.6468	0.6
14418	June 4	Distinct.	Cons.	0.90	4.20	1.95	.0014	.0360	.0218	.0142	.24	.0060	.0000	0.8284	0.8
14578	July 2	Distinct.	Slight.	1.20	3.95	1.75	.0030	.0358	.0282	.0076	.19	.0050	.0000	0.9930	0.8
14776	Aug. 5	Distinct.	Slight.	0.80	5.50	2.90	.0012	.0290	.0264	.0026	.22	.0160	.0001	0.8190	1.4
14966	Sept. 3	Slight.	Slight.	0.60	4.50	2.10	.0094	.0254	.0198	.0056	.29	.0050	.0000	0.5991	0.5
15307	Oct. 2	Distinct.	Slight.	0.48	4.90	1.90	.0000	.0304	.0282	.0022	.34	.0070	.0000	0.5772	0.6
15455	Nov. 2	Slight.	Slight.	1.10	4.50	2.30	.0002	.0324	.0282	.0042	.28	.0150	.0000	1.1872	0.9
15669	Dec. 3	V. slight.	Slight.	0.93	3.90	1.80	.0000	.0222	.0192	.0030	.17	.0030	.0000	0.8424	0.6
Av.	....	....	....	0.77	4.47	1.97	.0020	.0289	.0239	.0050	.26	.0090	.0003	0.7770	0.9

Averages by Years.

-	1892	-	-	0.62	3.70	1.49	.0014	.0194	.0158	.0036	.19	.0088	.0001	-	0.9
-	1893*	-	-	0.72	3.75	1.57	.0004	.0192	.0160	.0032	.26	.0044	.0001	.6477	0.9
-	1894	-	-	0.61	3.85	1.47	.0041	.0214	.0171	.0043	.29	.0027	.0001	.5830	0.7
-	1895	-	-	0.77	4.47	1.97	.0020	.0289	.0239	.0050	.26	.0090	.0003	.7770	0.9

* August to December.

NOTE to analyses of 1895: Odor, vegetable. —— The samples were collected from the river at Smith's Woollen Mill in Holden, and 1,000 feet from the line between Holden and West Boylston.

NASHUA RIVER.

Chemical Examination of Water from the Stillwater River in Sterling.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13594	Jan. 2	None.	V. slight.	.40	3.75	1.30	.0002	.0118	.0104	.0014	.20	.0070	.0000	.4697	1.1
13754	Feb. 4	V. slight.	V. slight.	.50	3.35	0.95	.0022	.0130	.0122	.0008	.20	.0030	.0000	.5372	0.6
13928	Mar. 5	V. slight.	Slight.	.30	3.35	1.40	.0008	.0116	.0102	.0014	.18	.0100	.0000	.4897	0.9
14076	Apr. 1	V. slight.	Cons.	.50	2.65	0.80	.0002	.0134	.0118	.0016	.14	.0030	.0000	.4851	0.3
14234	May 1	V. slight.	Slight.	.60	2.80	1.45	.0000	.0178	.0152	.0026	.16	.0030	.0000	.5582	0.8
14419	June 4	Slight.	Cons.	.60	3.35	1.40	.0008	.0204	.0176	.0028	.17	.0050	.0000	.6080	0.8
14577	July 2	Slight.	Slight.	.80	3.85	1.75	.0006	.0228	.0200	.0028	.14	.0030	.0000	.8271	0.9
14775	Aug. 5	Slight.	Slight.	.37	3.50	1.25	.0026	.0212	.0200	.0012	.18	.0150	.0001	.5070	1.8
14967	Sept. 3	Slight.	Slight.	.30	3.80	1.75	.0012	.0184	.0168	.0016	.18	.0000	.0000	.4119	0.8
15306	Oct. 2	Slight.	Slight.	.30	3.65	1.60	.0008	.0214	.0202	.0012	.27	.0030	.0000	.3838	0.8
15454	Nov. 2	Sl't., floc.	Slight.	.90	4.30	2.20	.0000	.0254	.0238	.0016	.28	.0070	.0001	.9828	0.9
15670	Dec. 3	None.	V. slight.	.68	3.45	1.55	.0000	.0172	.0150	.0022	.17	.0020	.0000	.6770	0.6
Av.	....	....	....	.52	3.48	1.45	.0008	.0179	.0161	.0018	.19	.0051	.0000	.5781	0.9

Averages by Years.

-	1892	-	-	.44	3.38	1.18	.0001	.0131	.0109	.0022	.13	.0072	.0000	-	0.9
-	1893*	-	-	.50	3.45	1.38	.0006	.0147	.0126	.0021	.18	.0022	.0001	.4931	0.7
-	1894	-	-	.45	3.20	1.14	.0008	.0137	.0115	.0022	.18	.0017	.0000	.4442	0.8
-	1895	-	-	.52	3.48	1.45	.0008	.0179	.0161	.0018	.19	.0051	.0000	.5781	0.9

* August to December.

NOTE to analyses of 1895: Odor, vegetable.——The samples were collected from the river at a highway bridge about 1 mile above the line between Sterling and West Boylston.

NASHUA RIVER.

Chemical Examination of Water from the South Branch of the Nashua River above Clinton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
13596	Jan. 2	Slight, milky.	Slight.	.48	4.95	1.85	.0002	.0230	.0212	.0018	.34	.0150	.0000	.5082	1.6
13752	Feb. 4	V. slight.	Slight.	.40	4.45	1.80	.0016	.0332	.0282	.0050	.32	.0180	.0000	.5490	1.3
13919	Mar. 4	Slight.	Slight, gray.	.30	3.95	1.25	.0036	.0200	.0130	.0070	.29	.0150	.0000	.4581	1.4
14080	Apr. 1	Slight.	Slight.	.48	3.15	1.20	.0014	.0176	.0146	.0030	.18	.0090	.0001	.4851	0.9
14233	May 1	Slight.	Cons.	.50	3.10	1.35	.0004	.0190	.0162	.0028	.22	.0050	.0001	.5120	0.8
14410	June 3	Slight.	Slight.	.55	3.60	0.95	.0030	.0192	.0142	.0050	.21	.0050	.0000	.5662	0.9
14553	June 29	Slight.	Cons.	.30	4.15	1.20	.0060	.0260	.0220	.0040	.28	.0030	.0002	.4440	1.3
14767	Aug. 5	Slight.	Slight.	.35	4.00	1.45	.0016	.0192	.0162	.0030	.24	.0150	.0001	.5382	1.6
14948	Sept. 1	Slight.	Slight.	.30	4.20	1.45	.0006	.0206	.0156	.0050	.27	.0050	.0000	.3927	1.9
15292	Oct. 1	Slight.	Slight.	.25	4.00	1.15	.0004	.0212	.0176	.0036	.30	.0030	.0000	.2746	1.4
15471	Nov. 4	Slight.	Slight.	.90	4.65	1.95	.0000	.0252	.0230	.0022	.29	.0100	.0002	.8908	1.1
15657	Dec. 2	Slight.	Slight.	.70	3.85	1.70	.0018	.0264	.0246	.0018	.19	.0050	.0000	.7862	0.9
Av.	....	....	....	.46	4.00	1.44	.0017	.0226	.0189	.0037	.26	.0090	.0001	.5338	1.3

Averages by Years.

-	1887*	-	-	.58	4.14	1.24	.0015	.0216	-	-	.21	.0077	-	-	-
-	1888	-	-	.32	3.53	1.06	.0008	.0151	-	-	.18	.0097	.0001	-	-
-	1889†	-	-	.24	2.96	0.87	.0004	.0163	.0133	.0030	.18	.0062	.0002	-	-
-	1893‡	-	-	.41	3.99	1.42	.0006	.0158	.0129	.0029	.28	.0020	.0001	.4623	1.4
-	1894	-	-	.44	3.81	1.27	.0014	.0154	.0123	.0031	.25	.0042	.0000	.4174	1.1
-	1895	-	-	.46	4.00	1.44	.0017	.0226	.0189	.0037	.26	.0090	.0000	.5338	1.3

* June to December. † January to May. ‡ August to December.

NOTE to analyses of 1895: Odor, vegetable, and frequently mouldy. —— The samples were collected from the river above the dam of the Lancaster Manufacturing Company.

NASHUA RIVER.

Chemical Examination of Water from the South Branch of the Nashua River, just above its Confluence with the North Branch at Lancaster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13669	Jan. 15	Distinct, milky.	Cons., dirty.	.60	5.25	1.95	.0196	.0300	.0228	.0072	.36	.0120	.0002	0.7268	1.1
13845	Feb. 19	Distinct.	Cons.	.55	5.10	1.90	.0152	.0204	.0158	.0046	.43	.0150	.0001	0.6006	1.6
14001	Mar. 19	Distinct.	Cons., dark.	.52	4.00	1.55	.0078	.0210	.0176	.0034	.23	.0180	.0002	0.6146	1.4
14155	Apr. 16	Distinct, clayey.	Cons.	.60	3.40	1.45	.0048	.0184	.0152	.0032	.23	.0080	.0001	0.6715	1.0
14338	May 21	Decided.	Cons., gray.	.50	4.50	1.45	.0136	.0252	.0192	.0060	.30	.0070	.0002	0.6241	1.3
14516	June 20	Distinct, milky.	Slight, dark.	.50	4.95	2.15	.0368	.0260	.0216	.0044	.38	.0050	.0006	0.5082	1.3
14701	July 24	Distinct.	Cons.	.50	3.90	1.40	.0114	.0120	.0098	.0022	.34	.0050	.0003	0.5082	1.6
14826	Aug. 13	Slight.	Slight.	.35	4.75	1.80	.0184	.0272	.0224	.0048	.33	.0110	.0013	0.5226	1.8
14909	Aug. 26	Distinct.	Cons., brown.	.35	5.15	1.90	.0116	.0140	.0108	.0032	.38	.0150	.0030	0.4953	1.1
15110	Sept. 9	Distinct, milky.	Cons., brown.	.30	5.45	1.10	.0496	.0264	.0236	.0028	.41	.0100	.0025	0.4836	1.9
15233	Sept. 23	Slight.	Cons., brown, floc.	.40	5.80	2.00	.0540	.0310	.0250	.0060	.52	.0150	.0050	0.4196	1.7
15325	Oct. 8	V. slight, milky.	V. slight.	.28	5.25	1.65	.0260	.0320	.0242	.0078	.56	.0100	.0027	0.3962	1.8
15409	Oct. 23	Slight.	Cons.	.97	5.70	2.85	.0084	.0284	.0268	.0016	.44	.0120	.0003	1.0748	1.6
15507	Nov. 11	Distinct.	Slight, brown.	.70	4.65	1.75	.0092	.0228	.0190	.0038	.30	.0130	.0002	0.7683	1.6
15607	Nov. 25	Distinct.	Slight.	.87	4.30	2.05	.0016	.0432	.0144	.0288	.21	.0080	.0002	0.9126	0.9
15751	Dec. 17	Slight.	Cons.	.48	4.35	1.85	.0038	.0198	.0168	.0030	.20	.0200	.0001	0.5852	1.3
Av.*	....	....	....	.53	4.66	1.77	.0167	.0238	.0185	.0053	.34	.0114	.0008	0.6146	1.4

Averages by Years.

-	1888†	-	-	.20	4.91	1.11	.0264	.0230	.0173	.0047	.38	.0192	.0008	-	-
-	1890‡	-	-	.30	4.68	1.85	.0162	.0288	.0213	.0075	.31	.0104	.0003	-	1.7
-	1891§	-	-	.45	6.01	2.22	.0141	.0338	.0242	.0096	.39	.0093	.0003	-	1.6
-	1892‖	-	-	.43	5.68	1.65	.0181	.0267	.0214	.0053	.59	.0150	.0006	-	1.8
-	1894¶	-	-	.52	6.31	1.91	.0532	.0285	.0226	.0076	.57	.0095	.0017	0.4758	1.8
-	1895	-	-	.53	4.66	1.77	.0167	.0238	.0185	.0053	.34	.0114	.0008	0.6146	1.4

* Where more than one sample was collected in a month the mean analysis for that month has been used in making the average.

† Four samples on September 17.

‡ Four samples in July and August.

§ August and October.

‖ August, October and November.

¶ July to December.

NOTE to analyses of 1895: Odor, generally musty and sometimes disagreeable; from July to September, generally vegetable.——The samples were collected from the river at the Atherton bridge, a short distance above its mouth.

NEPONSET RIVER.

An investigation of the condition of the Neponset River was made in August and September, 1895, and the results of the examination of samples of water from many points on the main river and its tributaries are given below. A similar investigation was made in 1891,

Chemical Examination of Water

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.			
									Albuminoid.		
			Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.
		1895.									
1	*16381	Aug. 23, 12.10 P.M.	V. slight.	V. slight.	0.90	7.30	3.50	0.0008	0.0236	.0232	.0004
2	16382	Aug. 23, 12.35 P.M.	V. slight.	Slight.	1.18	8.50	3.00	0.0010	0.0398	.0310	.0088
3	16383	Aug. 23, 1.30 P.M.	V. slight.	Slight.	1.01	7.80	2.50	0.0012	0.0352	.0290	.0062
4	16384	Aug. 23, 1.50 P.M.	Decided.	Decided.	0.65	32.20	10.30	0.0080	0.0780	.0440	.0340
5	16385	Aug. 23, 2.05 P.M.	Decided.	Decided.	0.89	28.80	8.90	0.0040	0.0660	.0420	.0240
6	16386	Aug. 23, 2.20 P.M.	Decided.	Heavy.	1.12	191.40	99.00	0.0100	0.4200	.0460	.3740
7	16387	Aug. 23, 3.45 P.M.	Decided.	Decided.	0.95	38.50	12.10	0.0060	0.0660	.0540	.0120
8	16388	Aug. 23, 4.00 P.M.	Decided.	Decided.	0.97	34.40	11.70	0.0060	0.0560	.0460	.0100
9	16389	Aug. 23, 4.15 P.M.	Decided.	Heavy.	1.85	83.50	27.20	1.2000	0.7800	.5300	.2500
10	16390	Aug. 23, 4.30 P.M.	Decided.	Heavy.	0.93	52.20	12.30	0.3100	0.2640	.1460	.1180
11	16391	Aug 23, 4.45 P.M.	Decided	Decided.	0.90	39.60	8.10	0.1580	0.2100	.1640	.0460
12	16392	Aug. 23, 5.20 P.M.	Decided.	Decided.	0.94	35.50	8.90	0.0800	0.1360	.0960	.0400
13	16393	Aug. 23, 5.30 P.M.	Decided.	Heavy.	1.90	544.00	121.00	3.0000	1.2400	.8700	.3700
14	16394	Aug. 23, 5.10 P.M.	Decided	Decided.	0.93	40.30	12.10	0.0840	0.1480	.1140	.0340
15	16426	Aug. 29, 11.50 A.M.	Decided.	Heavy.	1.02	46.97	11.17	0.1480	0.2120	.0720	.1400
16	16427	Aug. 29, 12.30 P.M.	Decided.	Decided.	1.00	35.40	9.50	0.1220	0.1560	.1040	.0520
17	16428	Aug. 29, 12.40 P.M.	Slight.	Decided.	0.98	10.30	4.30	0.0040	0.0360	.0220	.0140
18	16429	Aug. 29, 12.50 P.M.	Slight.	Decided.	0.90	11.20	4.70	0.0060	0.0560	.0340	.0220
19	16430	Aug. 29, 2.30 P.M.	Slight.	Slight.	1.01	14.20	5.10	0.0554	0.0648	.0508	.0140
20	16431	Aug. 29, 3.35 P.M.	Slight.	Slight.	0.91	13.50	4.50	0.0560	0.0608	.0460	.0148
21	16432	Aug. 29, 4.30 P.M.	V. slight.	Slight.	0.62	14.10	4.60	0.0654	0.0492	.0382	.0110
22	16433	Aug. 29, 5.25 P.M.	V. slight.	Decided.	0.65	15.50	6.90	0.0994	0.0460	.0394	.0066
23	16434	Aug. 29, 5.35 P.M.	V. slight.	Decided.	0.62	8.40	2.70	0.0026	0.0344	.0244	.0100
24	16435	Aug. 29, 5.45 P.M.	Slight	Decided.	0.63	11.80	5.10	0.0298	0.0492	.0374	.0118
25	16482	Sept. 5, 11.20 A.M.	V. slight.	Slight.	0.60	12.00	4.00	0.0640	0.0486	.0356	.0130
26	16483	Sept. 5, 11.55 A.M.	V. slight.	Slight.	0.59	10.85	5.35	0.0892	0.0466	.0406	.0060
27	16484	Sept. 5, 12.30 P.M.	Slight.	Decided.	0.60	-	-	0.0916	0.0514	.0386	.0128
28	16485	Sept. 5, 1.30 P.M.	Slight.	Decided.	0.62	20.80	7.05	0.0788	0.0540	.0436	.0104
29	16486	Sept. 5, 2.00 P.M.	V. slight.	Slight.	0.60	-	-	0.0526	0.0434	.0342	.0092
30	16487	Sept. 5, 2.30 P.M.	V. slight.	V. slight.	0.40	-	-	0.0492	0.0404	.0288	.0116

* These analyses were made at the Lawrence Experiment Station.

The samples were collected as follows: No. 16381, from the Neponset River where Main Street crosses it, just above the village of Walpole; No. 16382, at Stetson's dam, just below the village of Walpole; No. 16383, from the mill-pond of the paper-mill of F. W. Bird & Son, in East Walpole; No. 16384, at the Washington Street bridge in East Walpole, just below the paper-mill of F. W. Bird & Son; No. 16385, at the dam of the paper-mill of Hollingsworth & Vose, which is the next below the paper-mill of F. W. Bird & Son; No. 16386, about 100 feet below the paper-mill of Hollingsworth & Vose; No. 16387, at the next dam below the mill of Hollingsworth & Vose, at Water Street; No. 16388, at the Moore Street bridge in Norwood, about 100 feet above the brook which conveys the drainage from Winslow's Tannery to the river; No. 16389, from the brook which conveys the drainage from Winslow's Tannery to the Neponset River, about 100 feet above its junction with the river; No. 16390, from the Neponset River, about 100 feet below the brook from Winslow's Tannery; No 16391, at the dam of the Printing-ink Works of Geo. H. Morrill & Co., Pleasant Street, Norwood; No. 16392, from the Neponset

NEPONSET RIVER.

the results of which were given on pages 319–336 of the annual report for that year.

Both examinations were made at a time of low flow in the river, and a comparison of the analyses indicates that the condition of the river was generally worse in 1895 than at the time when the examination was made in 1891.

from the Neponset River.

[Parts per 100,000.]

Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.	Locality.	
0.45	.0010	.0000	0.76	71	Above Walpole.	1
0.78	.0000	.0000	1.11	37,500	Above Stetson's Dam.	2
0.60	.0010	.0000	0.98	900	Above paper-mill of F. W. Bird & Son.	3
2.18	.0010	.0000	2.68	57,400	Below paper-mill of F. W. Bird & Son.	4
1.81	.0000	.0000	3.00	238,000	Above paper-mill of Hollingsworth & Vose.	5
4.57	.0015	.0000	18.60	63,000	Below paper-mill of Hollingsworth & Vose.	6
3.03	.0000	.0000	3.60	470,000	Next dam below paper-mill of Hollingsworth & Vose.	7
2.81	.0020	.0000	3.20	Lost.	Above brook from Winslow's tannery.	8
17.16	.0100	.0006	5.70	336,000	Brook from Winslow's tannery.	9
7.25	.0050	.0000	4.00	385,000	Below brook from Winslow's tannery.	10
6.88	.0050	.0000	2.80	660,000	Above ink works.	11
5.69	.0030	.0000	2.40	600,000	Below ink works.	12
174.50	.0010	.0000	56.40	3,950,000	Sewer from Smith's tannery.	13
7.71	.0030	.0000	3.60	515,000	Below sewer from Smith's tannery and near head of meadows.	14
8.32	.0030	.0000	5.10	295,000	Below sewer from Smith's tannery and near head of meadows.	15
7.31	.0020	.0000	2.60	571,000	Above Canton River.	16
0.68	.0000	.0000	1.14	9,000	Canton River, near Main River.	17
1.35	.0020	.0000	1.26	171,000	Below Canton River.	18
1.67	.0010	.0000	1.28	33,000	Bridge at Dedham Road.	19
1.69	.0010	.0010	1.18	36,000	Bridge at Green Lodge Street.	20
1.79	.0000	.0000	1.04	5,000	Bridge at Milton Street.	21
2.15	.0030	.0000	1.02	7,000	Above Mother Brook.	22
0.53	.0080	.0000	0.76	17,000	Mother Brook.	23
1.09	.0100	.0000	0.94	22,000	Below Mother Brook.	24
1.41	.0070	.0002	0.72	11,000	Below Mother Brook.	25
2.39	.0070	.0004	0.90	6,000	Above Mattapan paper-mills.	26
2.40	.0050	.0004	0.96	7,000	Below Boston Gossamer Rubber Company.	27
2.41	.0090	.0004	0.98	7,000	Dam above Blue Hill Avenue, Mattapan.	28
1.47	.0070	.0008	0.82	5,000	Above Tileston & Hollingsworth paper-mill.	29
451.25	.0130	.0014	1.12	6,000	Tide water below Milton.	30

River, about 100 feet above the point where the sewer from Smith's Tannery enters the river; No. 16393, from the sewer leading from Smith's Tannery to the river; Nos. 16394 and 16426, from the river, 100 feet below the point where the sewer from Smith's Tannery enters it; No. 16427, from the river, just above the mouth of the Canton River; No. 16428, from the Canton River, about 100 feet above its confluence with the Neponset River; No. 16429, from the Neponset River, 1,000 feet below its confluence with the Canton River; No. 16430, from the Neponset River, where it is crossed by the Dedham Road; No. 16431, from the river, at Green Lodge Street; No. 16432, from the river, where it is crossed by Milton Street, just above Hyde Park; No. 16433, from the river, 100 feet above the outlet of Mother Brook; No. 16434, from Mother Brook; Nos. 16435 and 16482, from the Neponset River, about 1,000 feet below the point where it is joined by Mother Brook; No. 16483, at the dam of the paper-mill of Hollingsworth & Vose, below Hyde Park; No. 16484, below the factory of the Boston Gossamer Rubber Company; No. 16485, at the dam just above Blue Hill Avenue in Mattapan; No. 16486, at the dam of the paper-mill of Tileston & Hollingsworth; No. 16487, from the tide-water at Godfrey's wharf, below Milton.

NEPONSET RIVER.

Chemical Examination of Water from the Neponset River below the Outlet of the Sewer from Smith's Tannery, Norwood.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.
16731*	Oct. 9, at 6, 7.30, 9 and 11 P.M., . .	Decided.	Heavy.	0.99	50.20	13.50
16732	Oct. 10, at 4.50, 6, 7.30 and 9 A.M., .	Decided.	Heavy.	0.88	36.10	9.90
16733	Oct. 10, at 10.30 A.M., 12 M., 1.30 and 3 P.M.	Decided.	Heavy.	0.92	48.70	14.10
16734	Oct 10, at 4.15 P.M., ...	Decided.	Heavy.	1.00	53.00	14.00

Chemical Examination of Water from the Neponset River below the Outlet of the Sewer from Smith's Tannery, Norwood — Concluded.

[Parts per 100,000.]

Number.	Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Albuminoid.							
	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
16731*	.3000	.2800	.2080	.0720	11.49	.0040	.0000	4.40	501,000
16732	.1100	.1180	.0920	.0260	7.58	.0030	.0000	2.80	93,000
16733	.0900	.1580	.1200	.0380	12.32	.0030	.0000	3.68	346,000
16734	.1980	.2440	.1920	.0520	13.07	.0050	.0000	4.50	455,000

The samples were collected from the river, 100 feet below the outlet of the sewer from Smith's Tannery.

Chemical Examination of Water from the Neponset River above Hyde Park.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.
16735*	Oct. 9, at 6, 7.30, 9 and 11 P.M., . .	Slight.	Decided.	0.69	17.75	5.80
16736	Oct. 10, at 4.30, 6, 7.30 and 9 A.M., .	Slight.	Slight.	0.60	11.35	4.65
16737	Oct. 10, at 10.30 A.M., 12 M., 1.30 and 3 P.M.	Slight.	Slight.	0.59	11.15	3.00
16738	Oct. 10, at 4.30 P.M., ...	Slight.	Slight.	0.60	-	-

* These analyses were made at the Lawrence Experiment Station.

NEPONSET RIVER.

Chemical Examination of Water from the Neponset River above Hyde Park — Concluded.

[Parts per 100,000.]

Number.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
16735*	.0698	.0652	.0598	.0054	2.77	.0040	.0006	1.11	2,800
16736	.0372	.0448	.0428	.0020	1.49	.0070	.0006	0.79	5,900
16737	.0412	.0392	.0376	.0016	1.60	.0070	.0004	0.79	2,100
16738	.0528	.0480	.0424	.0056	1.89	.0040	.0004	0.80	2,600

The samples were collected from the river abont 200 feet above Paul's bridge at Milton Street, above the thickly settled portion of the town of Hyde Park.

Chemical Examination of Water from the Neponset River at Mattapan.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.
16739*	Oct. 9, at 6.30, 7.30, 9 and 11 P.M., .	Slight.	Decided.	0.52	16.25	4.95
16740	Oct. 10, at 4.30, 6, 7.30 and 9 A.M., .	Slight.	Decided.	0.52	20.30	7.55
16741	Oct. 10, at 10.30 A.M., 12 M., 1.30 and 3 P.M.	Slight.	Decided.	0.52	17.40	6.25
16742	Oct. 10, at 4.30 P.M., ...	Slight.	Decided.	0.54	17.10	6.05

Chemical Examination of Water from the Neponset River at Mattapan — Concluded.

[Parts per 100,000.]

Number.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
16739*	.0700	.0420	.0360	.0060	2.30	.0040	.0014	1.07	224,000
16740	.0640	.0700	.0400	.0300	2.68	.0040	.0010	1.06	60,000
16741	.0620	.0480	.0480	.0000	2.38	.0040	.0010	1.10	48,000
16742	.0620	.0580	.0500	.0080	2.02	.0040	.0004	1.16	147,000

The samples were collected from the river at the dam just above Blue Hill Avenue in Mattapan.

* These analyses were made at the Lawrence Experiment Station.

STONY BROOK.

Stony Brook.

Chemical Examination of Water from Stony Brook, Boston.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
14548	June 27	Slight.	Cons.	.25	11.45	3.45	.0018	.0074	.0052	.0022	1.50	.1000	.0012	.2487	4.0
14722	July 29	Slight.	Cons.	.40	10.50	4.05	.0038	.0224	.0170	.0054	2.05	.1050	.0018	.3388	4.3
14933	Aug. 29	V. slight.	Cons.	.33	12.45	3.65	.0256	.0186	.0152	.0034	1.58	.0600	.0027	.2262	4.8
15235	Sept. 24	V. slight.	Slight.	.60	12.35	3.25	.0090	.0174	.0138	.0036	2.00	.0580	.0040	.2746	4.2
Av.	....	....	....	.39	11.69	3.60	.0100	.0164	.0128	.0036	1.78	.0807	.0024	.2721	4.3

Odor, of the first two samples, faintly vegetable; of the last two, distinctly vegetable and mouldy. —— The first two and last samples were collected 1¼ miles above the Forest Hills railroad station, and the third sample at Forest Hills.

Ten Mile River.

Chemical Examination of Water from the Ten Mile River, at Attleborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1895.														
14675	July 22	Slight.	Cons.	1.10	5.65	2.50	.0090	.0298	.0250	.0048	.52	.0200	.0007	.8550	1.6
14676	July 22	Slight.	Cons.	0.40	4.60	1.75	.0018	.0238	.0210	.0028	.56	.0020	.0001	.3750	1.7

Odor, distinctly vegetable and unpleasant.——The first sample was collected from the river at West Street, just above the mouth of the Bungay River. The second sample was collected from the river about 1,000 feet below the railroad bridge on the main line of the Boston and Providence Railroad.

Ware River.

Chemical Examination of Water from Ware River at Cold Brook Station, Barre.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1895.														
13599	Jan. 4	V. slight.	V. slight.	0.65	5.70	2.25	.0038	.0376	.0360	.0016	.29	.0100	.0000	0.7715	1.6
13738	Feb. 4	V. slight.	V. slight.	0.60	4.45	1.45	.0028	.0196	.0156	.0040	.23	.0120	.0000	0.6873	1.3
13920	Mar. 5	V. slight.	Slight.	0.57	3.95	1.70	.0030	.0170	.0146	.0024	.16	.0070	.0000	0.6314	1.1
14057	Apr. 1	Slight.	Slight.	0.60	3.50	1.50	.0002	.0174	.0160	.0014	.13	.0070	.0000	0.6275	0.6
14219	May 1	V. slight.	Slight.	0.80	3.20	1.50	.0002	.0182	.0154	.0028	.17	.0030	.0000	0.7700	0.8
14398	June 3	Slight.	Slight.	1.20	3.45	1.80	.0026	.0264	.0252	.0012	.14	.0040	.0000	1.0336	1.1
14556	July 1	V. slight.	Slight.	1.05	4.45	2.10	.0004	.0216	.0180	.0036	.12	.0000	.0001	0.8745	0.6
14766	Aug. 5	V. slight.	Slight.	0.80	4.00	1.75	.0012	.0236	.0222	.0014	.16	.0100	.0001	0.8424	1.4
14961	Sept. 3	Distinct.	Slight.	0.50	3.65	1.05	.0012	.0196	.0184	.0012	.16	.0000	.0001	0.5544	0.5
15293	Oct. 1	Slight.	Slight.	0.60	3.30	1.20	.0000	.0198	.0188	.0010	.17	.0030	.0000	0.5242	0.6
15459	Nov. 4	Slight.	Slight.	1.00	4.35	2.40	.0006	.0242	.0230	.0012	.18	.0030	.0001	1.1973	1.3
15672	Dec. 4	V. slight.	V. slight.	0.98	3.55	1.70	.0004	.0176	.0160	.0016	.14	.0020	.0000	1.0078	0.5
Av.	....	....	....	0.78	3.96	1.70	.0014	.0219	.0199	.0020	.17	.0051	.0000	0.7935	0.9

Odor, vegetable. —— The samples were collected from the river, at the railroad bridge near Cold Brook station, in the south-easterly part of the town of Barre.

SUMMARY

OF

WATER SUPPLY STATISTICS;

ALSO

RECORDS OF RAINFALL AND FLOW OF STREAMS.

SUMMARY OF WATER SUPPLY STATISTICS.

During the year 1895 a public water supply was introduced for the first time into the towns of Barre, Longmeadow, Millbury, Monson and Rockport, and important additions to many of the existing works were made, to increase the capacity of existing sources of supply.

The following table gives a classification by population of cities and towns having and not having public water supplies December 31, 1895; the populations are taken from the census of 1895: —

Population (1895).	Number of Places of Given Population having a Public Water Supply.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having a Public Water Supply.	Total Population of Places in Preceding Column.
Under 500,	0	0	36	13,287
500-1,000,	3	2,323	56	43,481
1,000-1,500,	9	10,650	38	46,593
1,500-2,000,	7	12,115	32	55,361
2,000-2,500,	10	19,990	14	31,074
2,500-3,000,	6	16,873	12	32,618
3,000-3,500,	10	32,515	7	22,599
3,500-4,000,	5	18,219	1	3,569
4,000-4,500,	7	34,516	2	8,545
Above 4,500,	97	2,089,816	1	6,039
Totals,	154	2,237,017	199	263,166

From the totals given in the preceding table it will be seen that of the 353 cities and towns in the State 154, or 43.6 per cent., have a public water supply, and the total population of the places supplied represents 89.5 per cent. of the total population of the State. The number of people to whom a public water supply is available is somewhat less than the total population of the municipalities supplied, but the difference is not large. There are now but 11 towns having, by the

census of 1895, a population exceeding 3,000 which are not provided with a public water supply; these are given in the following table: —

Towns.	Population in 1895.	Towns.	Population in 1895.
Blackstone,	6,039	Pepperell,	3,321
Winchendon,*	4,490	Dudley,	3,203
Barnstable,	4,055	Chelmsford,	3,162
North Andover,	3,569	Dartmouth,	3,107
Sutton,	3,420	Deerfield,	3,007
Tewksbury,	3,379		

* Works for the supply of this town were under construction at the end of 1894.

In the following table the various water supplies are classified according to the dates when a fairly complete system of supply was first introduced into a city or town: —

Years.	Number of Places Supplied.	Years.	Number of Places Supplied.
Previous to 1850,	6	1891,	5
1850-1859, inclusive,	4	1892,	1
1860-1869, inclusive,	10	1893,	8
1870-1879, inclusive,	44	1894,	3
1880-1889, inclusive,	68	1895,	5
1890,	5	Total,	154

During the year 1895 the cities of Gloucester and Newburyport took possession of the works which were formerly owned by water companies. At the end of the year all of the 32 cities in the State, having an aggregate population of 1,616,632, owned their water works. Of the 123 towns having a public water supply, 77, with a total population of 407,806, own their works, while 46, having a total population of 212,579, are supplied by private companies. The total population in both cities and towns owning works is 2,240,438, against 212,579 in those supplied by private companies.

The growing tendency in recent years toward municipal control of water supplies is indicated by a comparison of the preceding

figures with similar figures for 1890. At that time 5 of the 28 cities in the State having public water supplies and 50 of the 109 towns were supplied by private companies. The total population of these cities and towns was 318,319, or 16 per cent. of the total population supplied, while in 1895 only 9.5 per cent. of the total population supplied was supplied by private companies.

The following table gives statistics with regard to the consumption of water in the cities and towns in this State where such records are kept. The consumption per inhabitant has been obtained by dividing the average daily consumption by the total population of the city or town in 1895, and consequently is somewhat less than the amount used per consumer, because there are in all cities and towns some who do not use the public water supply This difference is most marked in towns containing villages to which the public water supply has not been extended, and in towns where the works have been in operation but a short time and where water has not come into general use. In some towns the population during the summer months is much greater than is shown by the census returns, and in such cases the consumption per inhabitant as given in the table is somewhat higher than it would be if allowance should be made for the increased population in summer.

Statistics relating to the Consumption of Water in Various Cities and Towns.

City or Town.	Population. 1895.	Average Daily Consumption. Gallons. 1895.	Daily Consumption per Inhabitant. Gallons. 1895.	City or Town.	Population. 1895.	Average Daily Consumption. Gallons. 1895.	Daily Consumption per Inhabitant. Gallons. 1895.
Abington and Rockland.	9,730	407,000	42	Brockton,	33,165	1,095,000	33
Amesbury,	9,986	239,000	24	Brookline,	16,164	1,308,000	81
Andover,	6,145	331,000	54	Cambridge,	81,643	6,073,000	74
Attleborough,	8,288	306,000	37	Canton,	4,636	179,000	39
Avon,	1,626	62,000	38	Cohasset,	2,474	65,000	26
Ayer,	2,101	73,000	35	Cottage City,	1,038	58,000	56
Beverly,	11,806	810,000	69	Danvers and Middleton.	9,019	606,000	67
Boston (Cochituate Works).	456,616	50,801,100	112	Dedham,	7,211	411,000	57
Boston, Somerville, Chelsea, Everett (Mystic Works).	142,341	9,467,000	66	Easton,	4,452	82,000	18
				Fairhaven,	3,338	70,000	21
Bradford,	4,736	473,000	100	Fall River,	89,203	3,167,000	35
Braintree,	5,311	308,000	58	Foxborough,	3,219	141,000	44
Bridgewater and E. Bridgewater.	7,580	164,000	22	Framingham,	9,512	362,000	38

Statistics relating to the Consumption of Water in various Cities and Towns — Concluded.

City or Town.	Population. 1895.	Average Daily Consumption. Gallons. 1895.	Daily Consumption per Inhabitant. Gallons. 1895.	City or Town.	Population. 1895.	Average Daily Consumption. Gallons. 1895.	Daily Consumption per Inhabitant. Gallons. 1895.
Franklin,	5,136	201,000	39	Newburyport,	14,552	667,000	46
Gardner,	9,182	504,000	55	Newton,	27,590	1,802,000	65
Gloucester,	28,211	739,000	26	No. Attleborough,	6,576	183,000	28
Grafton,	5,101	85,000	17	North Brookfield,	4,635	92,000	20
Holliston,	2,718	79,000	29	Norwood,	4,574	268,000	59
Hopkinton,	2,984	33,000	11	Orange,	5,361	138,000	26
Hyde Park,	11,826	482,000	41	Peabody,	10,507	900,000	86
Lawrence,	52,164	3,005,000	57	Provincetown,	4,555	65,850	15
Lexington,	3,498	136,000	39	Quincy,	20,712	904,000	44
Longmeadow,	620	23,000	37	Randolph and Holbrook.	5,992	273,000	46
Lowell,	84,367	6,926,000	82	Reading,	4,717	199,000	42
Lynn and Saugus,	66,851	4,360,000	65	Revere and Winthrop.	11,615	874,000	75
Malden,	29,708	1,471,000	49	Rockport,	5,289	85,000	16
Manchester,	1,876	116,000	62	Salem,	34,473	2,163,000	63
Mansfield,	3,722	126,000	34	Sharon,	1,717	36,000	21
Marblehead,	7,671	268,000	35	Stoughton,	5,272	246,000	47
Marlborough,	14,977	510,000	34	Swampscott and Nahant.	4,124	408,000	99
Maynard,	3,090	78,000	25	Taunton,	27,115	1,159,000	43
Melrose,	11,965	849,000	71	Tisbury,	1,002	23,000	23
Methuen,	5,690	149,000	26	Wakefield and Stoneham.	14,588	612,000	42
Middleborough,	6,689	213,000	32	Waltham,	20,876	1,222,000	59
Milford,	8,959	527,000	59	Ware,	7,651	241,000	31
Milton,	5,518	133,000	24	Watertown and Belmont.	10,631	428,000	40
Montague,	6,058	320,000	53	Webster,	7,799	209,000	27
Nantucket,	3,016	89,000	30	Wellesley,	4,229	175,000	42
Natick,	8,814	382,000	43	Weymouth,	11,291	286,000	25
Needham,	3,511	139,000	40	Whitman,	5,744	187,000	32
New Bedford,	55,251	4,712,000	85	Woburn,	14,178	1,032,000	73

Rainfall.

The rainfall for the year 1895 was very slightly less than normal, the deficiency being 0.63 of an inch. There was an excess of rainfall in the months of April, July, October and November, and a deficiency in all the remaining months, the greatest deficiency occurring in February. The greatest excess occurred in the months of October and November. An exceptionally heavy rainfall occurred in the eastern part of the State from October 12 to 14, the greatest amount recorded being 8.49 inches at Framingham. The distribution of rainfall was such as to cause a very low flow in the streams in the latter part of August, in September and in the earlier portion of October. The average rainfall in Massachusetts, as deduced from long-continued observations in various parts of the State, is 45.30 inches. In the following table is given the normal rainfall in each month in 1895 and departures from the normal: * —

	Normal Rainfall. Inches.	Rainfall, 1895. Inches.	Excess or Deficiency. Inches.		Normal Rainfall. Inches.	Rainfall, 1895. Inches.	Excess or Deficiency. Inches.
1895.				**1895.**			
January,	3.97	3.51	−0.46	August,	4.42	3.37	−1.05
February,	3.64	1.07	−2.57	September,	3.38	2.69	−0.71
March,	3.87	2.91	−0.96	October,	4.13	7.16	+3.03
April,	3.34	4.67	+1.33	November,	4.06	6.28	+2.22
May,	3.72	2.47	−1.25	December,	3.71	2.96	−0.75
June,	3.20	3.08	−0.12				
July,	3.86	4.51	+0.65	Total,	45.30	44.67	−0.63

To enable the condition preceding the collection of samples of water in any part of the State to be understood, the following tables are presented, which give the daily rainfall in inches at nine stations scattered throughout the State: —

* This and the subsequent tables of rainfall have been prepared from the records of the New England Weather Service.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected.

January, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	0.40	*	0.71	*	*	0.41	*	*	*
7, . .	0.10	*	-	0.56	0.49	-	0.34	0.67	0.93
8, . .	0.21	1.03	0.07	*	0.25	-	0.01	-	*
9, . .	-	-	0.03	0.25	-	0.17	0.24	0.29	0.22
10, . .	-	*	0.30	*	*	*	*	*	*
11, . .	0.70	0.85	0.47	1.02	1.08	0.84	0.76	1.05	0.72
12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	0.07	0.06	0.07	0.08	0.02	0.05	0.08	0.10
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	0.13	0.31	0.32	0.46	0.50	0.38	0.43	0.60	*
17, . .	-	-	-	-	-	-	-	-	0.61
18, . .	*	*	-	0.20	0.18	-	0.08	-	-
19, . .	0.20	0.23	0.10	-	-	0.05	-	0.20	0.18
20, . .	-	-	-	-	-	-	-	-	-
21, . .	0.15	*	0.16	*	*	*	*	*	*
22, . .	-	0.22	0.04	0.24	0.24	0.29	0.32	0.23	0.31
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	0.13	0.49	1.03	0.92	0.93	1.02	1.49	0.95	0.54
27, . .	-	-	-	-	-	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	0.08	0.04	0.03	0.16	0.16	0.08	0.12	0.17	0.24
30, . .	-	-	-	-	-	-	-	-	-
31, . .	-	-	-	-	-	-	-	-	-
Totals,	2.10	3.24	3.32	3.88	3.91	3.26	3.84	4.24	3.85

February, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	0.09	0.12	0.07	0.15	0.20	0.06	0.18	0.25	0.30
3, . .	-	-	-	-	-	-	-	-	-
4, . .	0.07	0.01	0.11	0.14	0.25	0.09	*	0.14	0.17
5, . .	-	-	-	-	-	-	0.15	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	*	*	*	*	*	*	*	-	-
8, . .	0.90	0.47	1.06	1.13	0.38	0.84	0.90	0.82	0.32
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	0.06	-	-	-	-	-	-	-
21, . .	-	-	0.02	-	0.05	-	-	-	0.04
22, . .	-	-	0.02	0.03	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	-	-	-	-	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
Totals,	1.06	0.66	1.28	1.45	0.88	0.99	1.23	1.21	0.83

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

March, 1895.										April, 1895.									
Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	*	-	-	-	-	-	-	-	1, . .	-	-	-	-	-	*	-	*	0.01
2, . .	0.40	0.48	0.34	0.69	0.52	-	0.52	0.60	0.54	2, . .	-	-	-	-	-	0.01	-	0.04	0.10
3, . .	-	-	-	-	-	-	-	-	0.08	3, . .	0.20	-	0.23	0.39	-	0.35	0.43	0.36	0.36
4, . .	0.30	0.30	*	0.11	0.07	0.08	-	*	-	4, . .	-	-	-	-	0.44	-	-	-	-
5, . .	-	-	0.28	-	-	-	0.08	0.12	0.07	5, . .	-	-	-	-	-	-	-	-	-
6, . .	0.10	0.25	0.18	0.09	0.11	*	0.09	-	-	6, . .	0.20	-	-	-	-	-	-	-	-
7, . .	*	*	0.18	*	*	0.19	*	*	*	7, . .	-	-	-	-	-	-	-	-	0.10
8, . .	0.47	0.42	0.18	0.85	0.79	0.51	0.74	1.08	1.17	8, . .	1.03	1.90	0.14	-	-	-	-	*	-
9, . .	-	-	-	-	-	-	0.03	-	0.09	9, . .	-	0.30	1.22	*	0.94	0.70	0.95	1.59	1.62
10, . .	-	-	-	-	-	-	-	-	-	10, . .	2.00	-	0.07	1.29	0.26	0.11	-	0.39	0.50
11, . .	-	-	-	-	-	-	-	-	-	11, . .	-	-	-	-	-	-	-	-	-
12, . .	0.50	*	0.01	0.04	-	-	-	-	-	12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	0.70	0.05	*	-	-	*	-	-	13, . .	0.50	-	0.43	*	*	*	1.36	*	*
14, . .	-	-	0.81	0.76	0.80	0.89	1.10	1.23	1.62	14, . .	-	-	2.12	2.82	2.46	*	0.09	2.05	1.48
15, . .	0.03	-	0.08	*	*	*	0.10	*	*	15, . .	0.50	1.71	0.11	*	*	3.21	0.08	-	*
16, . .	-	-	-	0.08	0.16	0.11	-	0.28	0.52	16, . .	-	-	-	0.14	0.05	0.03	-	0.32	0.15
17, . .	-	-	-	-	-	-	-	-	-	17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-	18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-	19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-	20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	-	-	-	21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	0.02	-	-	-	-	22, . .	0.15	0.11	0.02	0.20	0.17	*	*	0.41	*
23, . .	-	-	-	-	-	-	-	-	-	23, . .	-	-	-	-	-	0.10	0.21	-	0.25
24, . .	-	-	-	-	-	-	-	-	0.01	24, . .	-	-	-	-	-	-	-	-	-
25, . .	0.05	0.11	0.14	0.12	0.13	0.13	0.10	0.11	0.10	25, . .	-	-	-	0.03	-	-	-	0.06	-
26, . .	0.02	-	-	-	-	-	-	0.03	0.01	26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	0.15	-	-	-	-	-	-	-	27, . .	1.44	0.28	0.19	0.29	0.15	*	0.10	*	0.01
28, . .	0.20	-	0.22	0.14	0.25	0.31	0.31	0.27	0.25	28, . .	0.05	-	-	-	-	0.17	-	0.25	0.99
29, . .	0.07	0.20	-	-	-	-	0.05	-	-	29, . .	0.10	-	-	0.19	-	-	-	-	-
30, . .	-	-	0.08	0.07	0.06	0.10	-	0.02	0.03	30, . .	-	0.17	0.20	0.03	0.13	0.26	0.14	0.08	0.24
31, . .	-	-	-	-	-	-	-	-	-										
Totals,	2.14	2.61	2.55	2.95	2.91	2.32	3.12	3.74	4.49	Totals,	6.17	4.47	4.73	5.38	4.60	4.94	3.36	5.55	5.81

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

May, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	0.09	0.10	*	-	-
5, . .	-	-	-	-	-	-	0.28	-	0.23
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	-	-	-	-	-	-	-
8, . .	0.05	0.21	0.06	-	-	-	-	-	-
9, . .	-	-	-	0.05	-	-	-	0.05	0.01
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	0.60	0.50	0.72	*	*	-	*	0.89	0.77
13, . .	-	-	-	0.67	1.19	0.79	1.20	0.18	0.29
14, . .	-	-	-	-	-	-	-	*	*
15, . .	0.30	0.12	0.48	0.57	0.65	0.20	0.63	1.20	0.96
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	0.15	0.15	0.07	0.26	0.25	0.13	0.21	0.40	0.52
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	0.03	*	*
22, . .	-	-	-	-	-	-	-	0.31	0.65
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	0.20	*	0.20	0.08	0.10	*	0.13	0.20	0.49
27, . .	0.70	1.00	0.79	0.26	0.30	0.11	-	0.40	0.29
28, . .	-	-	-	-	-	0.22	*	-	-
29, . .	-	-	-	-	-	-	0.21	-	-
30, . .	-	-	-	-	-	-	-	-	-
31, . .	0.05	0.05	-	0.05	-	-	0.11	0.32	0.02
Totals,	2.05	2.03	2.32	1.94	2.58	1.55	2.80	3.95	4.23

June, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	0.51	0.29	0.19	-	-	0.18
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	0.06	*	*	*	0.10	0.11	0.12
4, . .	1.20	-	0.28	*	0.11	0.09	-	0.16	0.39
5, . .	-	*	-	*	-	*	-	*	-
6, . .	0.40	1.58	0.10	0.55	0.12	0.19	0.12	0.06	0.18
7, . .	-	-	-	-	-	-	-	-	-
8, . .	-	-	-	-	-	-	-	-	-
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	-	0.40	0.16	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	0.03	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	0.03	-	-	-	-	-
22, . .	-	0.15	0.11	-	0.02	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	0.18	-	-	-	-	-	-	-
25, . .	-	-	0.95	0.67	0.27	0.81	0.27	0.36	1.07
26, . .	0.30	-	-	-	-	-	-	-	-
27, . .	0.25	0.80	0.43	-	*	-	*	*	*
28, . .	0.40	-	0.89	-	1.17	-	2.30	1.46	1.60
29, . .	0.30	0.55	-	1.15	-	1.62	-	-	-
30, . .	-	0.21	0.02	0.13	0.23	0.04	0.19	0.02	-
Totals,	2.85	3.47	3.24	3.23	2.21	2.94	2.98	2.17	3.54

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

July, 1895.										August, 1895.									
Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	0.05	-	-	0.07	0.05	0.06	0.55	1, . .	-	0.04	-	-	-	-	-	-	-
2, . .	0.20	-	-	-	-	-	-	-	-	2, . .	-	-	-	0.16	0.01	0.03	0.20	0.05	-
3, . .	-	-	-	-	-	-	-	-	-	3, . .	-	-	-	-	-	-	-	-	-
4, . .	0.30	-	0.05	0.32	0.50	*	*	0.75	0.75	4, . .	-	-	0.02	-	-	-	-	-	-
5, . .	-	-	0.06	*	-	0.06	0.16	-	-	5, . .	-	-	-	-	-	-	-	-	-
6, . .	*	0.36	0.44	0.80	0.40	0.19	0.04	0.41	0.60	6, . .	-	-	-	-	-	-	-	-	-
7, . .	0.60	-	-	-	-	-	-	-	-	7, . .	0.30	0.38	0.34	1.34	1.48	0.36	2.32	0.83	0.62
8, . .	-	-	-	-	-	-	0.04	-	-	8, . .	-	-	-	-	-	-	-	-	-
9, . .	-	0.83	4.13	0.40	1.31	0.81	1.35	0.86	0.10	9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-	10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-	11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-	12, . .	-	0.20	0.26	0.30	0.44	0.31	0.18	0.79	1.06
13, . .	1.20	0.44	0.28	0.43	0.45	0.54	*	0.26	0.40	13, . .	-	-	0.04	-	-	-	-	-	-
14, . .	-	-	0.04	0.08	-	0.21	0.51	-	0.74	14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	0.07	-	-	15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	0.23	0.10	0.06	0.05	*	*	0.53	0.24	16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	0.03	0.07	-	-	17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-	18, . .	1.50	1.70	0.77	1.21	1.17	1.44	1.67	1.21	0.77
19, . .	-	-	-	-	-	-	-	-	-	19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-	20, . .	-	-	-	0.03	-	-	-	-	-
21, . .	-	0.27	-	-	-	-	-	-	-	21, . .	-	-	-	-	-	-	-	-	0.04
22, . .	0.90	-	-	0.38	0.18	0.13	0.02	-	0.06	22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-	23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-	24, . .	*	-	0.08	0.01	0.01	0.09	-	-	-
25, . .	-	-	-	-	-	-	-	-	-	25, . .	0.10	-	-	-	-	-	-	-	-
26, . .	-	-	-	-	-	-	-	-	-	26, . .	-	-	-	-	-	-	-	-	-
27, . .	2.20	1.02	0.31	0.12	-	*	*	-	*	27, . .	-	-	-	-	-	-	-	-	-
28, . .	-	-	0.34	-	0.03	0.30	0.09	0.23	0.02	28, . .	0.10	0.42	-	0.18	-	-	-	0.19	0.02
29, . .	-	-	-	-	-	-	-	-	-	29, . .	-	-	0.14	0.02	0.08	0.02	-	-	-
30, . .	0.95	0.23	0.45	2.58	0.63	0.87	1.36	0.46	1.38	30, . .	-	-	-	-	-	-	-	-	-
31, . .	-	-	0.01	-	-	-	-	-	-	31, . .	0.90	-	0.44	0.75	0.72	0.24	0.59	0.70	-
Totals,	6.35	3.38	6.26	5.17	3.55	3.21	3.76	3.56	4.84	Totals,	2.90	2.74	2.09	4.00	3.91	2.49	4.96	3.77	2.51

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

September, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford
1, . .	-	-	-	-	-	-	-	-	0.25
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	-	-	-	-	-	-	-
8, . .	-	-	-	-	-	-	-	-	-
9, . .	*	0.78	0.31	-	-	0.24	*	-	-
10, . .	0.70	-	-	0.55	0.52	-	0.27	0.56	0.23
11, . .	0.60	1.25	0.37	0.14	0.75	0.21	0.39	0.06	0.03
12, . .	0.50	0.18	0.47	0.50	0.29	0.46	0.39	0.17	0.18
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	0.04	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	0.20	0.39	0.12	0.10	0.10	0.03	*	0.17	0.08
19, . .	-	-	0.03	-	-	-	0.09	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	0.48	0.54	-	-	-	-	-	-
26, . .	-	-	-	0.33	0.05	0.49	0.08	*	0.79
27, . .	-	-	-	-	0.15	0.04	0.13	1.03	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	*	-	-	-	-	-	-	-
30, . .	1.75	1.56	0.86	0.57	0.29	0.47	0.06	0.14	0.70
Totals,	3.75	4.64	2.70	2.19	2.15	1.98	1.41	2.13	2.26

October, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	*	0.11	0.02	-	-	-	-	0.02
8, . .	0.05	0.33	-	0.16	0.31	0.17	0.18	0.25	0.29
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	0.30	-	-	-	-	-	-	-	-
12, . .	*	*	-	*	*	*	*	*	*
13, . .	4.25	*	1.81	*	*	*	*	*	3.18
14, . .	-	2.57	3.90	8.49	7.55	4.82	5.27	5.09	0.20
15, . .	-	*	0.41	0.03	0.05	0.05	0.08	-	*
16, . .	-	0.11	-	-	-	-	-	-	0.02
17, . .	-	-	0.10	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	-	-	0.03
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	0.57	-	-	-	-	-	-	-
28, . .	0.30	-	0.28	0.06	0.03	0.06	0.03	-	-
29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-	-	-	-
31, . .	1.75	1.37	0.49	0.25	1.30	1.00	1.61	1.27	0.30
Totals,	6.65	4.95	7.10	9.01	9.24	6.10	7.17	6.61	4.04

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Concluded.

November, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	–	–	1.41	2.22	1.56	1.01	1.93	0.92	1.24
2, . .	0.54	*	0.48	*	*	*	*	0.88	*
3, . .	–	0.64	–	0.53	0.62	0.43	0.58	–	0.85
4, . .	–	–	–	–	–	–	–	–	–
5, . .	–	–	–	–	–	–	–	–	–
6, . .	–	–	–	–	–	–	–	–	–
7, . .	–	–	–	–	–	–	–	–	–
8, . .	–	–	–	–	–	–	–	–	–
9, . .	–	*	0.11	*	*	*	*	*	–
10, . .	0.25	0.33	0.08	0.16	0.15	0.13	0.16	0.05	0.07
11, . .	–	–	–	–	–	–	–	–	–
12, . .	–	–	–	–	–	–	–	–	–
13, . .	–	–	–	–	–	–	–	–	–
14, . .	1.50	*	0.15	*	*	–	*	*	*
15, . .	0.45	1.91	1.66	2.46	1.93	1.86	2.86	0.50	0.70
16, . .	–	–	–	–	–	–	–	–	–
17, . .	0.55	0.39	0.59	0.93	0.81	0.92	*	0.72	*
18, . .	–	–	–	–	–	–	0.73	–	0.80
19, . .	–	–	–	–	–	*	–	–	–
20, . .	0.48	0.30	0.22	0.06	0.68	0.48	0.70	0.85	0.35
21, . .	–	–	–	0.37	0.39	–	0.34	0.49	0.47
22, . .	–	–	–	–	–	*	–	–	–
23, . .	–	–	0.05	*	*	*	0.01	–	–
24, . .	0.20	*	0.20	0.22	0.18	0.36	0.16	0.14	0.09
25, . .	*	*	0.20	*	*	*	*	0.04	0.01
26, . .	0.34	1.27	0.51	2.05	0.12	0.27	0.14	–	*
27, . .	0.75	–	0.22	–	1.25	1.40	0.99	1.14	0.41
28, . .	–	–	–	–	–	–	–	–	–
29, . .	–	–	–	–	–	–	–	–	–
30, . .	–	–	–	–	–	–	–	–	–
Totals,	5.06	4.84	5.88	9.00	7.69	6.86	8.60	5.73	4.99

December, 1895.

Day of Month.	Ludlow.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	–	–	–	–	–	–	–	–	–
2, . .	0.48	0.72	0.48	0.30	0.16	0.20	–	0.42	*
3, . .	–	–	–	–	–	–	0.07	–	0.50
4, . .	–	–	–	–	–	–	–	–	–
5, . .	0.32	0.52	0.68	*	*	*	*	*	0.08
6, . .	–	–	0.15	0.96	0.56	0.63	0.73	0.63	0.36
7, . .	–	–	–	–	–	–	–	–	–
8, . .	–	–	–	–	–	–	–	–	–
9, . .	–	–	–	–	–	–	–	–	0.03
10, . .	–	–	–	–	–	–	–	–	–
11, . .	–	–	–	–	–	–	–	*	*
12, . .	–	–	–	–	–	–	–	*	0.05
13, . .	–	–	–	0.02	–	–	0.09	*	0.03
14, . .	–	–	–	–	–	–	–	0.30	–
15, . .	–	–	–	–	–	–	–	–	–
16, . .	–	–	–	–	–	–	–	–	–
17, . .	–	–	–	–	–	–	–	–	–
18, . .	–	–	–	–	–	–	–	–	–
19, . .	–	–	–	–	–	–	–	–	–
20, . .	–	–	–	–	–	–	–	–	–
21, . .	–	0.60	–	0.83	–	–	–	–	–
22, . .	1.30	–	0.73	–	0.60	0.71	0.73	0.92	0.71
23, . .	–	–	–	–	–	–	–	–	–
24, . .	–	–	–	–	–	–	0.02	–	0.03
25, . .	–	–	–	–	–	–	–	–	–
26, . .	–	*	0.03	*	–	*	–	–	–
27, . .	0.33	0.28	0.44	0.36	0.34	0.38	0.31	0.23	0.30
28, . .	–	–	–	–	–	–	–	–	–
29, . .	–	–	–	–	–	–	–	–	–
30, . .	*	–	0.16	*	*	*	*	*	*
31, . .	1.40	1.42	1.11	0.73	0.67	0.49	0.70	0.97	0.54
Totals,	3.83	3.54	3.78	3.20	2.33	2.41	2.65	3.47	2.63

* Precipitation included in that of following day.

Flow of Streams.

The flow of the streams of the State during the year 1895, as indicated by the flow of the Sudbury River, was a very little greater than the average for the past twenty-one years. In order to show the relation between the flow of the Sudbury River during each month in 1895 and the normal flow of the same river, as deduced from observations for twenty-one years from 1875 to 1895, inclusive, the following table has been prepared.

The area of the watershed of the Sudbury River above the point where its flow is measured is 75.2 square miles.

Table showing Average Monthly Flow of Sudbury River for the Year 1895, in Cubic Feet per Second per Square Mile of Drainage Area, also Departures from the Normal Flow.

Month.	Normal Flow. Cubic Feet per Second per Square Mile.	Actual Flow in 1895. Cubic Feet per Second per Square Mile.	Excess or Deficiency. Cubic Feet per Second per Square Mile.
January,	1.874	1.599	—0.275
February,	2.855	0.836	—2.019
March,	4.371	3.727	—0.644
April,	3.177	3.890	+0.713
May,	1.776	0.983	—0.793
June,	0.731	0.270	—0.461
July,	0.290	0.356	+0.066
August,	0.442	0.355	—0.087
September,	0.370	0.137	—0.233
October,	0.843	2.133	+1.290
November,	1.471	4.295	+2.824
December,	1.605	2.756	+1.151
Average,	1.644	1.791	+0.147

The next table shows the weekly fluctuations, during 1895, in the flow of the two streams most carefully measured, namely, the Sudbury and the Merrimack. The flow of these streams, particularly the Sudbury, will serve to indicate the condition of other streams in eastern Massachusetts.

Week ending Sunday.	Sudbury River. Cubic Feet per Second per Square Mile.	Merrimack River. Cubic Feet per Second per Square Mile.	Week ending Sunday.	Sudbury River. Cubic Feet per Second per Square Mile.	Merrimack River. Cubic Feet per Second per Square Mile.
Jan. 6,	0.346	0.493	July 7,	0.190	0.613
13,	1.214	0.537	14,	0.187	0.614
20,	1.138	0.760	21,	0.120	0.542
27,	0.999	0.657	28,	0.088	0.453
Feb. 3,	0.802	0.607	Aug. 4,	0.476	0.496
10,	0.600	0.517	11,	0.290	0.473
17,	0.486	0.482	18,	0.208	0.449
24,	0.446	0.493	25,	0.360	0.505
Mar. 3,	0.653	0.491	Sept. 1,	0.139	0.411
10,	1.483	0.709	8,	0.036	0.387
17,	3.523	1.392	15,	0.145	0.392
24,	2.072	1.419	22,	0.878	0.374
31,	2.302	1.902	29,	0.025	0.333
Apr. 7,	1.726	1.594	Oct. 6,	0.804	0.432
14,	2.507	4.975	13,	0.333	0.416
21,	4.165	8.093	20,	3.757	1.771
28,	1.432	3.050	27,	0.777	0.843
May 5,	0.988	2.020	Nov. 3,	1.427	0.986
12,	0.619	1.569	10,	1.636	1.321
19,	0.694	1.335	17,	2.137	1.826
26,	0.426	0.870	24,	3.226	2.523
June 2,	0.407	1.054	Dec. 1,	3.367	2.933
9,	0.307	0.826	8,	2.081	2.240
16,	0.240	0.629	15,	1.179	1.596
23,	—0.277	0.499	22,	1.282	1.182
30,	0.318	0.603	29,	2.016	2.903

In the annual report of the State Board of Health for the year 1890 (pages 338 to 340) a table, taken from the annual reports of the Boston Water Board, was printed, giving the records of rainfall upon the Sudbury River watershed and its yield, expressed in inches in depth on the watershed (inches of rainfall collected), for sixteen years, from 1875 to 1890, inclusive. The corresponding records for the years 1891 and 1892 were given in the annual report for 1892, and the records for the years 1893 and 1894 in the annual reports for those years. For convenience, the records from 1891 to 1894, inclusive, are reprinted in the following table, together with the record for 1895 and an average for the whole twenty-one years: —

Rainfall Received and Collected on the Sudbury River Watershed.

MONTH.	1891.			1892.			1893.			1894.			1895.			MEAN FOR 21 YEARS, 1875-1895.		
	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.
	Inches.	Inches.		Inches.	Inches.		Inches.	Inches.		Inches.	Inches.		Inches.	Inches.		Inches.	Inches.	
January,	7.020	5.383	76.69	5.850	3.335	57.01	2.925	0.773	26.44	4.090	1.236	30.22	4.060	1.844	45.4	4.325	2.161	48.4
February,	5.235	5.616	107.28	3.140	1.574	50.13	8.195	2.485	30.32	3.910	1.596	40.82	1.395	0.871	62.5	4.136	2.998	78.6
March,	6.475	7.944	122.69	4.060	3.488	85.90	3.670	5.789	157.74	1.435	3.992	278.19	2.980	4.299	144.2	4.375	5.039	130.1
April,	3.905	4.138	105.97	0.830	1.504	181.15	3.605	3.668	101.75	3.415	2.832	82.93	5.250	4.341	82.7	3.339	3.545	113.3
May,	2.010	1.039	51.70	5.585	2.245	40.20	6.610	5.143	77.81	4.235	1.498	35.37	2.020	1.134	56.1	3.415	2.048	71.9
June,	3.770	0.714	18.92	2.760	0.739	26.76	2.380	0.759	31.88	1.155	0.723	62.60	2.770	0.301	10.8	2.886	0.816	29.8
July,	3.395	0.266	7.83	4.230	0.382	9.03	2.570	0.282	10.96	3.255	0.287	8.82	5.040	0.411	8.2	3.764	0.334	9.5
August,	4.725	0.290	6.15	4.440	0.500	11.26	5.415	0.322	5.95	2.030	0.373	18.37	4.150	0.409	9.9	4.209	0.510	13.8
September,	2.380	0.350	14.71	2.840	0.396	13.94	1.735	0.187	10.75	2.635	0.258	9.79	2.300	0.153	6.7	3.029	0.414	13.8
October,	3.830	0.375	9.78	1.170	0.224	19.18	4.065	0.395	9.72	5.345	0.668	12.50	10.680	2.460	23.0	4.557	0.971	19.4
November,	3.090	0.526	17.03	5.800	1.204	20.75	2.195	0.550	25.07	3.425	1.442	42.10	6.625	4.794	72.4	4.135	1.641	39.4
December,	3.685	0.971	26.34	1.125	0.865	76.89	4.860	1.421	29.23	4.810	1.277	26.55	3.350	3.179	94.9	3.676	1.851	60.8
Totals and averages,	49.520	27.612	55.76	41.830	16.456	39.34	48.225	21.774	45.15	39.740	16.182	40.72	50.620	24.196	47.8	45.845	22.328	48.0

The Sudbury River records are particularly valuable as a basis for estimating the yield of other watersheds in Massachusetts, both on account of the accuracy with which the measurements have been made during the whole twenty years, and the absence of abnormal conditions which would unfavorably affect the results. It is therefore thought advisable to publish in the following table those portions of the records relating to the yield of this watershed for each of the twenty years; and in doing so the flow from the watershed is expressed in gallons per day per square mile, instead of inches in depth of rainfall collected, in order to render the table more convenient for use in estimating the probable yield of watersheds used as sources of water supply.

*Yield of the Sudbury River Watershed in Gallons per Day per Square Mile.**

Month.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.
January, ...	103,000	643,000	658,000	1,810,000	700,000	1,121,000	415,000	1,241,000
February, ...	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000
March, ...	1,604,000	4,435,000	4,813,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000
April, ...	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,168,000	1,546,000	867,000
May, ...	1,188,000	1,139,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000
June, ...	870,000	222,000	597,000	506,000	413,000	176,000	1,338,000	529,000
July, ...	321,000	183,000	202,000	128,000	158,000	177,000	276,000	86,000
August, ...	396,000	405,000	121,000	475,000	395,000	119,000	148,000	55,000
September, ...	207,000	184,000	60,000	160,000	141,000	80,000	197,000	306,000
October, ...	646,000	234,000	632,000	516,000	71,000	101,000	186,000	299,000
November, ...	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	210,000
December, ...	584,000	454,000	1,289,000	3,177,000	462,000	175,000	775,000	314,000
Average for whole year,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000
Av. for driest six months,	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000

Month.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
January, ...	335,000	995,000	1,235,000	1,461,000	2,589,000	1,053,000	2,782,000	1,254,000
February, ...	1,033,000	2,842,000	1,354,000	4,800,000	2,829,000	1,951,000	1,195,000	1,529,000
March, ...	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000	3,237,000	1,339,000	3,643,000
April, ...	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000	2,645,000	1,410,000	1,875,000
May, ...	938,000	1,030,000	1,336,000	720,000	1,009,000	1,632,000	880,000	1,366,000
June, ...	300,000	417,000	426,000	203,000	414,000	422,000	653,000	568,000
July, ...	115,000	224,000	62,000	115,000	114,000	117,000	633,000	108,000
August, ...	78,000	257,000	240,000	94,000	214,000	380,000	1,432,000	132,000
September, ...	91,000	44,000	121,000	118,000	111,000	1,155,000	824,000	458,000
October, ...	186,000	83,000	336,000	146,000	190,000	1,999,000	1,230,000	2,272,000
November, ...	205,000	175,000	1,178,000	673,000	368,000	2,758,000	1,941,000	1,215,000
December, ...	193,000	925,000	1,174,000	1,020,000	643,000	3,043,000	2,241,000	997,000
Average for whole year,	533,000	1,129,000	901,000	1,087,000	1,154,000	1,697,000	1,383,000	1,285,000
Av. for driest six months,	145,000	200,000	391,000	223,000	234,000	953,000	944,000	747,000

* The area of the Sudbury River watershed used in making up these records included water surfaces amounting to about one per cent. of the whole area, from 1875 to 1878 inclusive, and subsequently increasing by the construction of storage reservoirs to about three per cent. in 1886. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile — Concluded.

Month.	1891.	1892.	1893.	1894.	1895.	Mean for 21 Years, 1875-1895, Inclusive.
January,	3,018,000	1,870,000	433,000	693,000	1,034,000	1,212,000
February,	3,486,000	943,000	1,542,000	991,000	541,000	1,845,000
March,	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	2,825,000
April,	2,397,000	871,000	2,125,000	1,640,000	2,515,000	2,053,000
May,	582,000	1,259,000	2,883,000	840,000	636,000	1,148,000
June,	414,000	428,000	440,000	419,000	174,000	473,000
July,	149,000	214,000	158,000	161,000	231,000	187,000
August,	163,000	280,000	181,000	209,000	229,000	286,000
September,	203,000	229,000	108,000	150,000	89,000	240,000
October,	210,000	126,000	221,000	374,000	1,379,000	545,000
November,	305,000	697,000	319,000	836,000	2,777,000	950,000
December,	544,000	485,000	797,000	716,000	1,782,000	1,038,000
Average for whole year,	1,315,000	781,000	1,037,000	770,000	1,152,000	1,062,000
Av. for driest six months,	239,000	327,000	237,000	356,000	456,000	398,000

THE HARDNESS OF WATER

AND

METHODS BY WHICH IT IS DETERMINED.

By ELLEN H. RICHARDS, S.B.

THE HARDNESS OF WATER AND METHODS BY WHICH IT IS DETERMINED.

Not the least important consideration which may influence the choice of a water supply is that regarding the quantity of calcium and magnesium salts it contains, and which give to it the property known as "hardness."

Excessive hardness renders a water unfit for many domestic uses, because of the waste of soap in the laundry and its injurious effect on cooking utensils and on some foods. As a question of economy, therefore, the amount of calcium and magnesium salts in a water is of importance. The separation and determination of the different mineral salts in water is a somewhat long and tedious process. The weight of the residue on evaporation, taken alone, does not furnish the information sought, for the residue may consist chiefly of potassium or sodium salts, which do not cause water to have the objectionable quality of hardness which is imparted to it by the salts of calcium and magnesium. A ready means, therefore, of determining at least the relative hardness of a given sample is valuable, and this means is found in the soap-destroying power of different waters.

A difficulty in the way of making the determination of hardness by the amount of soap required to give a permanent lather lies in the indefiniteness of the various substances known as "soap," and much confusion has arisen from the effort to construct scales of "degrees" of hardness on this basis.

Dr. Edward Frankland* avoided this difficulty by stating the results in terms of calcium carbonate in 100,000 parts of water, thus making the determination more accurate and consistent with the other results of analysis.

This method (described later), with all the precautions carefully observed, has been used in all the chemical work of the Massachusetts State Board of Health since 1872.

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* Water Analysis, 1880.

If calcium carbonate and chloride were the only salts to be met with, or if calcium and magnesium salts occurred separately in waters, the results would be quantitative ; but, as the salts usually occur mixed in unknown proportions, the figures given under the heading "hardness" are accurate only within limits.

As recorded in the reports of the State Board of Health, the figures under "hardness" indicate the number of grams of calcium carbonate which, dissolved in 100,000 grams (100 litres) of distilled water, would decompose as much soap as would 100 litres of the water in question. If the mineral salt was magnesium carbonate or calcium sulphate, the figure would be slightly different; and if two or three of these compounds were present, yet a different figure would be given. Ordinary soaps contain from 23 to 31 per cent. of water, and in combining power have been found to vary from 75 to 90 per cent. of the value of the standard soap used in the determinations, with a tendency to the lower limit. Not to burden this paper with the long series of experiments and calculations made, it may be said that, on an average which includes some wide variations, the weight of soap required to give a lather which will remain five minutes is ten to twelve times the weight of the calcium and magnesium salts.

From the figures under the heading "hardness," in the tabulated analyses, an estimate may be made as follows: —

If the hardness of a water is given as 9.0, it means that in 100,000 pounds of water there is, of calcium and magnesium salts, a quantity which gives the same hardness to water which would be given by 9 pounds of calcium carbonate. In order to soften this water for manufacturing purposes about 9 pounds of soda ash will be required, and for laundry purposes about 90 pounds of soap.

Massachusetts is, as regards hardness, exceptionally fortunate in her water supplies. Of 153 sources supplying 143 cities and towns, only 13 per cent. show over 4 parts per 100,000 of hardness, while half of the remaining 87 per cent. have a hardness below 1.5 parts, and 13.7 per cent. of the whole number have a hardness of less than 0.5 of one part. Of the 19 supplies which have a hardness of more than 4, six are between 4 and 5, four are between 5 and 6, three are between 6 and 10, one is between 10 and 15, five are over 15.

Methods of Determination of Hardness.

1. *By Soap, — Clark's Method.*

When potassium or sodium soap is added to water containing calcium and magnesium salts, the soap is decomposed, and insoluble compounds with the fatty acids are produced.

Upon this decomposition of soap is based the method for the determination of "lime salts" which was perfected and patented by Thomas Clark * in 1841. Variously modified by French, German and English chemists, the principles he formulated proved of general application. He employed sixteen standard calcium carbonate solutions, containing from one to sixteen "degrees of hardness," one degree meaning one grain of calcium carbonate to the imperial gallon. The soap solution was prepared by dissolving hard soap in proof spirits and making up to such a strength that 100 test measures of the standard calcium carbonate solution of 16 degrees of hardness should take 32 test measures of soap solution, a test measure being $\frac{1}{7000}$ part of a gallon.

Hardness may be temporary, caused by the presence of bicarbonates which are decomposed by boiling heat, with the liberation of carbon dioxide (carbonic acid), or permanent, caused by compounds other than the bicarbonates. In the Clark process the total hardness is determined on the unboiled water and the permanent on the boiled, the difference being the temporary hardness. The total hardness only is given in the results tabulated in the State Board of Health reports.

The solutions used in the laboratory for water analysis are made as follows: —

A standard calcium chloride solution is prepared by dissolving 0.2 gram of Iceland spar in dilute hydrochloric acid in a platinum dish and evaporating to dryness, redissolving in a small amount of water and again evaporating to dryness. This is repeated several times, until all the free acid is removed and a perfectly neutral salt remains which is dissolved in water and made up to one litre. One cubic centimeter then contains calcium chloride equivalent to 0.0002 gram calcium carbonate.

For the preparation of the standard soap solution 100 grams of the best quality of dry, white Castile soap is cut into thin shavings, dissolved in dilute alcohol (500 cubic centimeters alcohol, 96 per

* Clark's Process, Repertory Patent Inventions, 1841.

cent., and 500 cubic centimeters of distilled water) and allowed to stand over night to settle; 100 cubic centimeters of the clear liquid are then made up to two litres, enough alcohol being used to keep all of the soap in solution. Fifty cubic centimeters of the standard solution of calcium chloride, which, according to the table, should take exactly 14.25 cubic centimeters of standard soap, are used to test its strength. The solution thus prepared does not change perceptibly if air has no access to it, and, if used with a siphon burette attached to the bottle, will keep for five or six weeks or longer. It contains 5.2 grams of Castile soap to the litre.

For the standardization of the soap and for the determination of the hardness of any water, 50 cubic centimeters of the water to be tested or of the standard calcium chloride solution are placed in a flask or bottle of 200 cubic centimeters capacity and of a convenient shape, and the soap solution added, two or three tenths of a cubic centimeter at a time, shaking well after each addition, until a lather is obtained which is permanent for five minutes, and covers the entire surface of the liquid with the bottle placed on its side.

The following table gives the hardness corresponding to the number of cubic centimeters of soap solution used in the analyses: —

Table of Hardness.

Volume of Soap Sol. c.c.	Hardness. ($CaCO_3$ per 100,000.)	Volume of Soap Sol. c.c.	Hardness. ($CaCO_3$ per 100,000.)	Volume of Soap Sol. c.c.	Hardness. ($CaCO_3$ per 100,000.)
0.7	0.00	3.7	4.16	6.7	8.43
0.8	0.16	3.8	4.29	6.8	8.57
0.9	0.32	3.9	4.43	6.9	8.71
1.0	0.48	4.0	4.57	7.0	8.86
1.1	0.63	4.1	4.71	7.1	9.00
1.2	0.79	4.2	4.86	7.2	9.14
1.3	0.95	4.3	5.00	7.3	9.29
1.4	1.11	4.4	5.14	7.4	9.43
1.5	1.27	4.5	5.29	7.5	9.57
1.6	1.43	4.6	5.43	7.6	9.71
1.7	1.56	4.7	5.57	7.7	9.86
1.8	1.69	4.8	5.71	7.8	10.00
1.9	1.82	4.9	5.86	7.9	10.15
2.0	1.95	5.0	6.00	8.0	10.30
2.1	2.08	5.1	6.14	8.1	10.45
2.2	2.21	5.2	6.29	8.2	10.60
2.3	2.34	5.3	6.43	8.3	10.75
2.4	2.47	5.4	6.57	8.4	10.90
2.5	2.60	5.5	6.71	8.5	11.05
2.6	2.73	5.6	6.86	8.6	11.20
2.7	2.86	5.7	7.00	8.7	11.35
2.8	2.99	5.8	7.14	8.8	11.50
2.9	3.12	5.9	7.29	8.9	11.65
3.0	3.25	6.0	7.43	9.0	11.80
3.1	3.38	6.1	7.57	9.1	11.95
3.2	3.51	6.2	7.71	9.2	12.11
3.3	3.64	6.3	7.86	9.3	12.26
3.4	3.77	6.4	8.00	9.4	12.41
3.5	3.90	6.5	8.14	9.5	12.56
3.6	4.03	6.6	8.29		

The importance of adding the soap solution in small quantities cannot be too strongly emphasized, especially in the presence of magnesium compounds. If much carbonic acid be liberated, it is well to follow the original directions and remove it by suction. It will be observed that the table does not admit of the determination of hardness above 12.5 parts. In case the water under examination requires more than 10 cubic centimeters of the standard soap solution, a smaller portion of 25 cubic centimeters, 10 cubic centimeters, or even 2 cubic centimeters, as the case may require, is measured out and made up to a volume of 50 cubic centimeters with recently distilled water. This will keep the results comparable with each other, although the element of dilution introduces a slight error into the calculation.

2. *By Acid,—Hehner's Method.*

Attempts have been made to determine the calcium and magnesium salts by means of standard acid and alkaline solutions instead of by soap. An exhaustive study of the relative practical value of one of these, as compared with the soap method, was made in 1890 in the laboratory of the State Board of Health. A condensed summary of the results is here given.

The standard solutions used are sodium carbonate, 1.06 grams to the litre, one cubic centimeter corresponding to 0.0001 gram calcium carbonate, and sulphuric acid of such a strength that one cubic centimeter will exactly neutralize one cubic centimeter of the standard sodium carbonate (0.98 gram of sulphuric acid to one litre).

For the determination of the temporary hardness, 100 cubic centimeters of the water to be tested, tinted with lacmoid, which is the best indicator to use with surface waters, are heated nearly to boiling in a porcelain dish, and the standard acid added to a neutral reaction. Each cubic centimeter of acid corresponds to one part of calcium carbonate per 100,000.

For the permanent hardness, another 100 cubic centimeters of water are taken, and enough of the standard sodium carbonate solution added to more than decompose the salts of calcium and magnesium, and the whole evaporated to dryness in a platinum or nickel dish. (Glass and porcelain cannot be used, as too large an error is introduced from the alkali dissolved from these substances.) The residue is first treated with boiling distilled water, which has been boiled for a few minutes to remove any carbonic acid, and then

filtered through a small filter which must be well washed, the filtrate tinted with lacmoid and the excess of free alkali determined by the standard acid.*

The number of cubic centimeters of sodium carbonate used, less the acid used for neutralization, gives the permanent, and the sum of the two gives the total, hardness.

With alkaline waters, with sewage and with some sewage effluents, a correction must be made for the excess of alkaline carbonates; but in these cases the results after correction do not compare as closely with the soap method as do those obtained with the natural waters.

The following tabulated results were obtained by the two methods, which were tried on a number of ground and surface waters and several samples of sewage, in every case the total hardness being given: —

Surface Waters.

[Parts per 100,000.]

Place of Collection.	Total Hardness by Soap.	Total Hardness by Acid.
Fitchburg, Overlook Reservoir,	0.48	0.70
Springfield, Ludlow Reservoir, 6 feet beneath the surface,	0.79	1.11
Springfield, Ludlow Reservoir, at surface,	0.79	1.00
Quincy, Reservoir,	0.79	0.80
Lawrence, Merrimack River,	0.80	1.11
Brockton, Reservoir,	0.90	0.80
Quincy, inlet to Reservoir,	0.95	0.70
Worcester, Holden Reservoir,	0.95	1.10
Millville, Blackstone River,	1.10	1.50
Boston Water Works, Basin 4, 20 feet beneath the surface,	1.11	1.11
Boston Water Works, Basin 4, 4 feet beneath the surface,	1.27	1.00
Lawrence, Merrimack River,	1.30	1.60
Boston Water Works, Cold Spring Brook, at head of Reservoir No. 4,	1.43	1.40
Boston Water Works, Reservoir No. 2,	1.46	1.45
Boston Water Works, Sudbury River, at head of Reservoir No. 2,	1.56	1.30
Boston Water Works, Reservoir No. 4, near bottom,	1.56	1.55
Boston Water Works, Reservoir No. 3,	1.80	1.90
Framingham, Farm Pond,	1.95	1.90
Marlborough,	2.30	2.00
Boston Water Works, Stony Brook, at head of Reservoir No. 3,	2.34	2.35
Winchester, Reservoir,	2.60	2.70
Worcester, Blackstone River,	2.86	2.90
Poughkeepsie, inlet of filter-basin,	4.00	4.00
Poughkeepsie, inlet of east filter-bed,	4.00	4.00
Poughkeepsie, inlet of west filter-bed,	4.00	4.00
Poughkeepsie, Hudson River,	4.57	4.50

* Analyst, vol. viii, 77, 1883.

These two methods were then tried upon three samples of sewage, the results of which show wide differences: —

Place of Collection.	Total Hardness by Soap.	Total Hardness by Acid.
No. 1,	4.20	5.80
No. 2,	3.90	7.20
No. 3,	3.60	5.60

These three samples were strongly alkaline, in every case the acid method giving the higher results.

Ground Waters.

Place of Collection.	Hardness by Soap.	Hardness by Acid.	Place of Collection.	Hardness by Soap.	Hardness by Acid.
Whitman, well,	1.80	1.70	Woburn, well,	4.90	4.40
Whately, well,	2.08	2.00	Winchester, well,	5.10	6.80
South Deerfield, well,	2.21	1.95	Hatfield, well,	5.14	4.70
Melrose, well,	2.30	2.40	South Deerfield, well,	5.71	5.40
Melrose, well,	2.50	3.20	South Deerfield, well,	5.71	5.42
Greenfield, well,	2.73	2.20	Hatfield, well,	6.00	6.30
Melrose, well,	2.90	3.50	Williamsburg, well,	6.29	8.80
Framingham, filter-basin,	3.10	3.10	Winter Hill, well,	7.00	7.70
Orange, well,	3.40	3.40	Malden, well,	7.10	7.30
Melrose, well,	3.50	4.70	South Framingham, under-drain.	7.70	7.70
Reading, well,	3.60	4.90	Malden, well,	7.90	8.80
Malden, well,	3.60	5.60	Reading, well,	10.00	10.10
Cambridge, well,	4.20	5.80	Framingham, well,	10.10	9.80
Cambridge, well,	4.40	4.90	Reading, well,	11.50	10.50
Boston, well,	4.40	4.90	Amherst, well,	12.56	12.30
Williamsburg, well,	4.57	4.20	Williamstown, spring,	34.40	30.35
Reading, well,	4.60	4.50	Chelsea, well,	17.30	17.10
Saugus, well,	4.70	6.30	Chelsea, well,	17.50	17.40
Amherst, well,	4.71	4.45	Williamstown, well,	34.40	30.35

The extent to which the presence of magnesium salts affects the results is well shown in the following table, which gives not only the total nardness but the amount of each salt which caused it, as deter-

mined by analysis. It is possible by careful manipulation to precipitate the calcium by means of ammonium oxalate, and, after filtering, to determine the hardness due to the remaining magnesium salts.

[Parts per 100,000.]

	Total Solids.	$Ca\ CO_3$.	$Mg\ CO_3$.	Solids causing Hardness.	Hardness by Soap.
Swampscott, tubular wells, ...	21.10	6.71	3.02	9.73	10.00
Swampscott, tubular wells, ...	20.10	6.05	3.05	9.10	9.10
Swampscott, large well, ...	34.00	9.91	4.21	14.12	14.37
Marblehead, large well, ...	13.70	3.32	1.51	4.83	4.85
Marblehead, tubular wells, ...	39.10	8.45	4.05	12.50	12.86

The foregoing results show that the simpler soap method gives results agreeing fairly well with the more tedious acid method, and it is therefore desirable to retain it for regular use in determining the hardness of waters for domestic use. It has, moreover, the advantage of being a more direct expression of the amount of soap wasted in using a water.

EXPERIMENTS

UPON THE

PURIFICATION OF SEWAGE AND WATER

AT THE

LAWRENCE EXPERIMENT STATION,

DURING THE YEAR 1895.

EXPERIMENTS UPON THE PURIFICATION OF SEWAGE AND WATER AT THE LAWRENCE EXPERIMENT STATION.*

By Harry W. Clark, Chemist in Charge.

The year 1895 is the eighth that the experimental work of the Lawrence Experiment Station has been continued. The work has been carried on under the general supervision of Hiram F. Mills, A.M., C.E., a member of the State Board of Health. Mr. Geo. W. Fuller, biologist, was in direct charge of the station until August, 1895, when the writer, who had previously been in charge of the chemical department, succeeded Mr. Fuller in charge of the station. Mr. W. R. Copeland is in charge of the biological department, with Mr. Lewis Weinberg as assistant biologist. Mr. F. B. Forbes is assistant chemist. Profs. T. M. Drown and W. T. Sedgwick, of the Massachusetts Institute of Technology, have been, respectively, consulting chemist and biologist, having a general oversight of the chemical and biological investigations.

The investigations at the Lawrence Experiment Station during the year 1895 have been along the same general lines as in previous years, and additional and valuable data upon the subjects of sewage and water purification have been obtained. The question of the permanency of sewage filters and the best methods of management to secure this permanency, preliminary treatment of sewage by different methods to remove sludge before filtration, and different methods of aerating sewage filters to secure the greatest efficiency, quantitative and qualitative, have been studied. In addition to this, studies of the composition of sewage have been continued, and investigations of methods for the disposal or utilization of waste liquors of industrial works have been begun.

The investigations upon water filtration have been directed towards the subjects of high rates of filtration and the effectiveness of shallow

* A full account of the work done at the Lawrence Experiment Station for the years 1888 and 1889 is contained in a special report of the State Board of Health upon the Purification of Sewage and Water, 1890. A similar account for the years 1890 and 1891 is contained in the twenty-third annual report of the Board for the year 1891. Since 1891 the results have been published yearly in the annual reports.

filters compared with deeper, the influence of period of use upon the qualitative and quantitative efficiency of filters, the efficiency of sands of a character not before used, and studies of the operation and results — chemical, bacterial and hygienic — obtained by the Lawrence city filter. A portion of the investigation into the condition of the Neponset River has been carried out by the force employed at the laboratories of the station.

Filtration of Sewage.

The sewage applied to the experimental filters is drawn through a 2.5 inch pipe, 4,300 feet long, from the Lawrence Street sewer at a point just below the main business street of the city and just above the entrance of wastes from the large mills. This sewer drains the streets, houses and stores of the most densely populated section of the city.

When the investigations at the station were begun, the sewage drawn from this sewer was of a composition and strength quite different from the sewage used at the present time. There are a number of reasons for this change, the most important being the use at the present time of *day* sewage only at the station, and a large increase in the number of house connections with the sewer. Low rainfall and a smaller consumption of water per capita also have an influence.

Table showing Comparison of Average Analyses of Sewage applied to Experimental Filters at Different Periods.

[Parts per 100,000.]

Period.	Free Ammonia.	Albuminoid Ammonia. Total.	Soluble.	Insoluble.	Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
1895,	4.05	1.00	.28	.72	11.43	5.10	2,907,000
1894,	3.43	0.63	.26	.37	8.07	3.86	1,330,000
1888-1893,	2.09	0.67	.30	.37	6.64	3.64	870,000

Composition of Sewage and Results of Analyses of Sewage applied to Experimental Filters.

The above table shows that the sewage of 1894 was stronger than the sewage of the six preceding years, and that during 1895 it was still stronger than in 1894. The quantity of free ammonia

and the numbers of bacteria present have both largely increased, the total albuminoid ammonia is much greater than heretofore, while the quantity of insoluble albuminoid ammonia is nearly double that of any previous year. Analyses of samples of sewage collected directly from the Lawrence Street sewer, at the point where the pipe from the sewer to the station begins, have been made each week during the year. These samples have been collected almost invariably between eight and nine o'clock in the morning, when the strongest sewage of the day is passing through the sewer. The results of the monthly averages of these analyses are given in the next table, and the second table beyond shows the results of the monthly analyses of the regular station sewage. The greater quantity of free ammonia and the lower quantity of oxygen consumed in the station sewage are due to the slow passage of the sewage through the 2.5 inch pipe from the sewer to the station, with the consequent bacterial and chemical changes. It will also be noticed that the sewage taken directly from the Lawrence Street sewer has invariably contained nitrogen in the form of nitrates and nitrites and also free dissolved oxygen, and that these substances have disappeared when the sewage reaches the station.

Monthly Averages of Analyses of Sewage from the Lawrence Street Sewer.

[Parts per 100,000.]

1895.	Temperature. Deg. F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	Soluble.	Insoluble.		Nitrates.	Nitrites.		
January, . .	48	3.93	1.19	.63	.56	7.71	.17	.0115	7.75	3,830,000
February, . .	46	2.70	1.02	.64	.38	9.19	.15	.0140	6.10	1,277,000
March, . .	46	2.37	1.02	.68	.34	12.56	.25	.0220	6.84	1,328,000
April, . .	46	2.50	1.07	.62	.45	10.66	.26	.0185	8.90	1,687,000
May, . . .	56	2.87	.99	.54	.45	21.78	.25	.0342	5.16	3,836,000
June,. . .	63	3.28	.93	.45	.48	16.92	.09	.0175	5.45	3,712,000
July, . . .	67	3.73	.94	.47	.47	17.67	.14	.0108	5.98	2,410,000
August, . .	71	1.78	.73	.39	.34	9.73	.09	.0000	5.95	3,870,000
September, .	72	2.10	.94	.47	.47	11.03	.18	.0000	6.78	1,938,000
October, . .	60	2.27	.74	.47	.27	10.18	.17	.0350	6.52	1,892,000
November, .	61	1.91	.76	.51	.25	7.91	.19	.0000	5.30	2,217,000
December, .	53	2.21	.86	.56	.30	7.96	.23	.0146	7.72	3,716,000
Average, .	57	2.64	.93	.54	.43	11.94	.18	.0148	6.54	2,642,750

On at least four days in each week a bottle of sewage has been taken for analysis from a large tank of sewage at the station, and this sewage is known as the "regular" sewage.

Monthly Averages of Analyses of Regular Sewage Samples.

[Parts per 100,000.]

1895.	Temperature, Degrees F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	Soluble.	Insoluble.			
January,	41	3.57	1.21	.30	0.91	9.03	6.81	2,654,000
February,	41	3.71	0.99	.33	0.66	11.40	5.44	1,678,000
March,	44	4.03	0.87	.38	0.49	9.42	5.82	1,916,000
April,	45	3.82	0.88	.30	0.58	8.96	5.44	2,113,000
May,	58	3.71	0.57	.22	0.35	10.53	3.49	2,293,000
June,	69	4.24	1.95	.25	1.70	13.07	3.50	3,431,000
July,	69	4.41	0.89	.23	0.66	14.37	5.19	2,909,000
August,	70	4.31	1.02	.23	0.79	16.98	5.63	3,422,000
September,	68	4.58	1.03	.25	0.78	14.57	5.44	3,073,000
October,	54	4.21	0.87	.27	0.60	10.47	5.34	3,037,000
November,	54	3.93	0.76	.28	0.47	9.47	4.10	3,144,000
December,	48	4.10	0.95	.37	0.58	8.83	5.02	5,213,000
Average,	55	4.05	1.00	.28	0.72	11.43	5.10	2,907,000

Other Samples of Sewage collected for Analysis.

In addition to the sewages represented by the preceding tables, it has been the practice to collect other representative samples for analysis, as follows: —

1. A sample representing an average of all the sewage pumped on each Tuesday of the year.

2. Samples representing an average of all the sewage applied to filters Nos. 1, 6 and 9 A.

3. On each Tuesday of the year a sample of the supernatant liquid, after allowing regular sewage to stand for four hours.

4. On each Tuesday of the year a sample of the supernatant liquid, after treating the regular sewage of the day with sulphate of alumina in the proportion of 1,000 pounds per 1,000,000 gallons, and allowing to stand and settle for four hours.

5. On each Tuesday of the year a sample of the liquid resulting from straining regular sewage through a layer of coke breeze.

Monthly Averages of Analyses of Average Sewage Samples.

[Parts per 100,000.]

1895.	Free Ammonia.	Albuminoid Ammonia Total.	Albuminoid Ammonia Soluble.	Albuminoid Ammonia Insoluble.	Chlorine.	Oxygen Consumed.	Fats.
January,	3.85	.72	.35	.37	7.53	3.98	4.1
February,	4.20	.87	.42	.45	10.56	4.80	5.7
March,	3.70	.75	.38	.37	8.50	4.97	3.9
April,	3.45	.77	.34	.43	10.97	5.00	-
May,	4.43	.77	.33	.44	19.61	3.33	8.1
June,	4.79	.83	.35	.48	12.85	4.17	4.4
July,	4.14	.65	.28	.37	15.37	3.54	5.7
August,	3.91	.54	.20	.34	12.71	3.70	8.1
September,	5.24	.77	.28	.49	14.30	4.27	6.4
October,	4.00	.70	.28	.42	11.21	2.75	2.8
November,	3.99	.73	.38	.35	9.27	3.93	7.1
December,	4.14	.74	.42	.32	10.71	4.94	3.1
Average,	4.15	.74	.33	.40	11.97	4.12	4.4

Monthly Averages of Mixed Samples, representing all of the Sewage applied to Filters Nos. 1, 6 and 9 A.

[Parts per 100,000.]

1895.	Free Ammonia. Filter No. 1.	Free Ammonia. Filter No. 6.	Free Ammonia. Filter No. 9 A.	Albuminoid Ammonia. Filter No. 1.	Albuminoid Ammonia. Filter No. 6.	Albuminoid Ammonia. Filter No. 9 A.	Oxygen Consumed. Filter No. 1.	Oxygen Consumed. Filter No. 6.	Oxygen Consumed. Filter No. 9 A.	Chlorine. Filter No. 1.	Chlorine. Filter No. 6.	Chlorine. Filter No. 9 A.
January,	4.71	3.81	4.61	.95	.67	.81	5.55	4.38	5.38	7.55	7.85	8.20
February,	4.13	4.00	4.45	.41	.67	.85	5.40	4.50	5.48	8.83	8.80	8.89
March,	3.86	3.26	4.23	.87	.62	.89	6.10	4.78	8.45	10.84	7.87	11.10
April,	3.83	3.87	4.15	.90	.81	.86	5.80	5.33	5.43	15.66	9.04	9.03
May,	3.97	4.06	4.34	.66	.61	.69	3.75	3.40	3.30	12.66	8.93	7.88
June,	4.33	4.45	4.62	.74	.73	.73	3.74	3.64	3.64	16.32	15.00	11.15
July,	4.69	4.39	4.46	.60	.56	.59	3.80	3.20	3.43	16.57	12.25	14.76
August,	4.29	4.11	4.40	.56	.55	.50	3.72	3.18	3.28	14.52	15.88	13.62
September,	4.65	4.68	4.13	.76	.84	.69	4.43	4.33	3.93	13.31	12.48	11.93
October,	4.53	3.94	4.48	.75	.61	.75	4.35	3.30	4.38	8.79	7.49	8.41
November,	4.38	4.22	4.00	.80	.79	.74	4.84	3.70	3.76	7.75	7.18	6.93
December,	4.15	3.79	3.60	.90	.71	.65	5.90	4.48	4.10	7.92	8.31	6.96
Average,	4.29	4.05	4.29	.74	.68	.73	4.78	4.00	3.55	11.73	10.09	9.91

Monthly Averages of Analyses of Supernatant Liquid from Settled Sewage, for Filter No. 13 A.

[Parts per 100,000.]

1895.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. Soluble.	Albuminoid Ammonia. Insoluble.	Chlorine.	Oxygen Consumed.	Fats.	Bacteria per Cubic Centimeter.
January,	4.26	.61	.41	.20	9.22	3.86	4.3	2,270,000
February,	4.81	.64	.48	.16	8.88	4.02	6.0	1,597,000
March,	4.77	.70	.47	.23	13.74	5.05	2.7	1,454,000
April,	4.52	.66	.47	.19	13.19	3.70	-	1,917,000
May,	4.23	.45	.28	.17	12.56	2.50	2.4	1,955,000
June,	4.82	.46	.29	.17	17.15	2.85	1.0	1,447,000
July,	4.23	.39	.26	.13	14.64	2.92	4.6	1,914,000
August,	3.91	.36	.18	.18	12.11	2.47	1.8	1,501,000
September,	4.71	.46	.22	.24	14.97	2.42	3.0	1,435,000
October,	4.98	.46	.28	.18	12.39	3.50	0.9	2,510,000
November,	4.08	.51	.33	.18	10.58	3.48	5.3	2,471,000
December,	4.31	.58	.38	.20	7.80	3.98	3.8	3,749,000
Average,	4.47	.52	.34	.19	12.27	3.40	3.3	2,018,000

Monthly Averages of Analyses of Supernatant Liquid from Sewage treated with Sulphate of Alumina, for Filter No. 19.

[Parts per 100,000.]

1895.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. Soluble.	Albuminoid Ammonia. Insoluble.	Chlorine.	Oxygen Consumed.	Fats.	Bacteria per Cubic Centimeter.
January,	3.77	.36	.26	.10	8.42	2.20	1.9	734,000
February,	3.40	.33	.21	.12	10.16	2.23	1.0	245,000
March,	4.68	.50	.36	.14	12.89	4.23	3.9	496,000
April,	4.20	.39	.27	.12	11.10	2.90	-	1,033,000
May,	4.02	.28	.19	.09	10.45	1.83	1.5	1,313,000
June,	4.63	.38	.20	.18	12.69	2.30	1.8	1,252,000
July,	4.23	.37	.23	.14	14.89	2.30	2.8	1,530,000
August,	4.65	.36	.21	.15	14.21	2.15	1.3	2,222,000
September,	5.17	.42	.25	.17	25.48	2.65	2.5	1,583,000
October,	4.48	.33	.24	.09	12.80	2.70	0.7	1,380,000
November,	3.95	.36	.29	.07	10.44	2.28	2.8	836,000
December,	4.27	.40	.27	.13	7.32	2.90	1.2	1,135,000
Average,	4.29	.37	.25	.12	12.57	2.39	1.9	1,147,000

Monthly Averages of Analyses of Sewage strained through Coke, for Filter No. 14 A.

[Parts per 100,000.]

1895.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. Soluble.	Albuminoid Ammonia. Insoluble.	Chlorine.	Oxygen Consumed.	Fats.	Bacteria per Cubic Centimeter.
January,	4.21	.48	.33	.15	8.65	3.06	-	1,344,000
February,	4.74	.53	.41	.12	8.34	3.40	6.0	742,000
March,	5.54	.67	.47	.20	12.84	4.40	4.6	1,150,000
April,	4.40	.50	.34	.16	11.04	3.13	-	840,000
May,	4.10	.34	.24	.10	12.90	2.27	2.8	1,646,000
June,	4.61	.39	.22	.17	21.50	2.25	1.2	888,000
July,	4.67	.39	.25	.14	17.86	1.96	3.0	1,160,000
August,	4.48	.30	.19	.11	14.35	1.83	1.5	998,000
September,	5.59	.42	.23	.19	17.99	2.65	3.3	1,969,000
October,	4.35	.52	.33	.19	13.55	3.10	1.0	1,822,000
November,	4.65	.55	.34	.21	10.45	3.03	6.6	1,883,000
December,	4.08	.38	.26	.12	7.62	2.48	2.8	1,554,000
Average,	4.62	.46	.30	.16	13.09	2.80	3.3	1,333,000

Summarizing these results, we find that, by allowing the sewage to settle in barrels for four hours and then drawing a sample for analysis from a faucet half-way between the top and bottom of the barrel, this sample shows a removal of 48.0 per cent. of the organic matter (total albuminoid ammonia) and 31.0 per cent. of the bacteria. By this same treatment, together with the addition of sulphate of alumina, a removal of 63.0 per cent. of the organic matter and 61.0 per cent. of the bacteria has been obtained. By straining sewage through a layer of coke, 54.0 per cent. of the organic matter and 54.0 per cent. of the bacteria have been removed from the entire volume of sewage strained.

Comparison of the Strength of Station Sewage.

Bringing together for comparison the average results of analyses of the several series of samples of untreated sewage, we have: —

[Parts per 100,000.]

1895.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. Soluble.	Albuminoid Ammonia. Insoluble.	Chlorine.	Oxygen Consumed.	Total Nitrogen.
Regular,	4.05	1.00	.28	.72	11.43	5.10	4.96
Average,	4.15	0.74	.33	.41	11.97	4.12	4.61
For Filter No. 1,	4.29	0.74	.33*	.41	11.73	4.78	4.73
For Filter No. 6,	4.05	0.68	.30*	.38	10.09	4.00	4.43
For Filter No. 9 A,	4.29	0.73	.33*	.40	9.91	3.55	4.71

* Estimated.

Composition of Sewage.

During 1895, series of samples of sewage from Framingham, Marlborough and the Worcester State Lunatic Hospital have been taken in continuation of the studies of the strength and composition of the sewage applied to different filtration areas in the State. All chemical samples were treated, immediately upon collection, with mercuric acetate in the proportion of 1 part to 4,000, to kill the bacteria and prevent decomposition between the time of collection and of analysis. A separate sample was taken for the immediate determination of the dissolved oxygen present, and still another set of samples was taken, from which plantings for the determination of the number of bacteria present were made. These samples were all taken during cooler weather in 1895 than in 1894, and, consequently, the percentage of dissolved oxygen present was greater.

It will be noticed that all samples were taken at a point where the sewage entered a settling basin. The special features in regard to the places where samples were taken in 1895 were given in the report for 1894, but, for accurate understanding, are repeated.

Worcester State Lunatic Hospital. — Situated on the outskirts of the city, and not connected with the city sewers. Practically all the water entering the sewer passes through a meter on the city service pipes. The number of inhabitants on the day when the series was

taken was 980. The samples were collected, as in 1894, at a man-hole several hundred feet from the buildings, and just above the settling tank through which the sewage passes on its way to the irrigating field. The high temperature of the sewage is due to the fact that a considerable portion of the water supply is used for laundry purposes six days in the week. The sewage is very fresh at the point of collection of samples; that is to say, the mixture of organic pollutions and water has very recently taken place, and, owing to this fact, the sewage uniformly contains nitrogen in the form of nitrates and nitrites, and the proportion of free ammonia to organic nitrogen is very low. In fact, the sewage is so fresh that good and representative samples are collected with difficulty, as the floating matters are not well broken up before reaching the point of collection. The measurements of the flow of sewage were taken from the meter readings giving the volume of water used.

Marlborough. — The sewerage system of this city is of the so-called separate type; but, as there are no underdrains beneath the sewers, a considerable volume of ground water enters them. The length of the outfall sewer, from the last lateral to the point where it discharges into the settling tank at the filter field, is about four miles.

The following series of samples was taken October 30, at the man-hole just as the sewage enters the settling tank. Measurements of the rate of flow were made by noting the length of time taken to fill one of the compartments of this tank. Free oxygen was present in the sewage during the entire twenty-four hours.

Framingham. — The sewerage system is arranged with underdrains beneath the principal sewers to carry off the ground water. The series was collected October 30, at the point where the sewage enters the collecting basin, about one mile from the village. Free oxygen was present in the sewage during the entire twenty-four hours.

In regard to the tables given, it may be said that the samples analyzed were made up of equal portions of sewage taken at the hours enclosed by brackets. The average analysis given in each case is a simple average of the determinations given, and is not, of course, an exact representative analysis of the sewage of the day.

It is proposed during the coming year to take more frequent samples in each series, and that these samples shall be in some measure proportional to the rate of flow of the sewage.

Results of Analyses of Samples of Sewage collected Hourly from the Main Sewer at the Worcester State Lunatic Hospital.

[Parts per 100,000.]

Date — 1895.	Hour.	Rate of Flow. — Gallons passed between Samples.	Temperature. — Deg. F.	Bacteria per Cubic Centimeter.	Per Cent. of Dissolved Oxygen.	Ammonia.		Chlorine.	Organic Nitrogen by Kjeldahl Method.	Nitrogen as		Total Nitrogen. — (Organic Nitrogen by Kjeldahl Method)	Oxygen Consumed.		Hardness.	Fats.
						Free.	Albuminoid.			Nitrates.	Nitrites.		Two Min.	Five Min.		
October 17, . . .	12.45 P.M.	-	74	473,000	65.1											
17, . . .	1.45 P.M.	1,915	70	357,000	54.4	0.8000	.6700	3.02	1.80	.08	.0032	2.54	5.30	10.20	7.2	4.6
17, . . .	2.45 P.M.	3,493	66	273,000	67.0											
17, . . .	3.45 P.M.	2,394	68	525,000	70.6											
17, . . .	4.45 P.M.	2,693	68	525,000	83.7											
17, . . .	5.45 P.M.	3,426	64	455,000	51.0	0.8500	.6400	3.99	2.89	.09	.0070	3.68	5.00	9.70	8.2	7.7
17, . . .	6.45 P.M.	3,925	71	490,000	56.1											
17, . . .	7.45 P.M.	2,304	65	280,000	77.9											
17, . . .	8.45 P.M.	1,795	64	175,000	71.8											
17, . . .	9.45 P.M.	1,765	64	205,000	79.1	1.2500	.7200	5.44	5.51	.10	.0022	6.64	2.80	6.20	10.9	2.0
18, . . .	5.15 A.M.	9,126	63	245,000	86.6											
18, . . .	6.00 A.M.	1,331	72	145,000	69.3											
18, . . .	7.35 A.M.	7,570	71	413,000	70.7											
18, . . .	9.00 A.M.	18,587	75	735,000	64.6	0.8500	.6700	3.29	2.80	.06	.0024	3.56	7.90	11.10	10.0	5.9
18, . . .	10.30 A.M.	785	71	508,000	70.7											
18, . . .	12.00 M.	7,929	70	560,000	70.0											
Average, . .	....	69,038*	68.5	397,750	69.3	0.9375	.6750	3.93	3.25	.06	.0037	4.10	5.25	9.30	9.1	5.1

* Total flow for twenty-four hours.

Results of Analyses of Samples of Sewage collected Hourly from the Main Sewer at Marlborough.

[Parts per 100,000]

Date — 1895.	Hour.	Rate of Flow. — Gallons per 24 Hours.	Temperature. — Deg. F.	Bacteria per Cubic Centimeter.	Per Cent of Dissolved Oxygen.	Ammonia.		Chlorine.	Organic Nitrogen by Kjeldahl Method.	Nitrogen as		Total Nitrogen. — (Organic Nitrogen by Kjeldahl Method)	Oxygen Consumed.		Hardness.	Fats.
						Free.	Albuminoid.			Nitrates.	Nitrites.		Two Min.	Five Min.		
October 30, . . .	11.00 A.M.	789,600	52	2,520,000	31.5											
30, . . .	12.00 M.	861,322	52	6,900,000	23.9	3.9000	1.1700	7.79	2.85	.11	.0750	6.24	4.80	7.60	19.0	5.0
30, . . .	1.00 P.M.	823,816	55	2,485,000	19.2											
30, . . .	2.00 P.M.	902,118	52	3,910,000	23.0											
30, . . .	3.00 P.M.	758,016	52	2,588,000	29.5	2.9000	0.6700	7.41	1.58	.15	.0650	4.17	3.80	5.40	16.4	4.5
30, . . .	4.00 P.M.	789,600	52	1,225,000	32.6											
30, . . .	5.00 P.M.	823,816	52	2,485,000	38.3											
30, . . .	6.00 P.M.	823,816	52	2,750,000	27.4	2.1500	0.5300	7.29	1.35	.19	.0650	3.37	3.40	5.10	14.8	3.0
30, . . .	7.00 P.M.	823,816	52	1,960,000	30.3											
30, . . .	8.00 P.M.	676,424	52	1,008,000	32.6											
30, . . .	9.00 P.M.	728,406	52	595,000	27.0	1.9500	0.3100	8.58	0.98	.14	.0500	2.77	1.70	2.70	13.8	1.7
30, . . .	10.00 P.M.	701,428	52	928,000	39.3											
31, . . .	5.15 A.M.	592,200	51	525,000	70.9											
31, . . .	6.00 A.M.	592,200	51	595,000	75.3	1.0100	0.2300	4.91	0.33	.39	.0300	1.58	0.24	0.40	6.0	0.8
31, . . .	7.00 A.M.	592,200	51	525,000	81.9											
31, . . .	8.00 A.M.	573,776	51	525,000	90.3											
31, . . .	9.00 A.M.	701,428	52	1,470,000	85.3	2.2500	0.4300	4.39	0.48	.33	.0300	2.69	0.36	0.54	8.2	1.3
31, . . .	10.00 A.M.	728,406	52	1,890,000	55.5											
Average, . .	....	737,910	51.9	1,938,000	45.2	2.3600	0.5600	6.73	1.26	.22	.0525	3.47	2.38	3.62	13.0	2.7

Results of Analyses of Samples of Sewage collected Hourly from the Main Sewer at Framingham.

[Parts per 100,000.]

Date — 1895.	Hour.	Rate of Flow. — Gallons passed between Samples.	Temperature. — Deg. F.	Bacteria per Cubic Centimeter.	Per Cent. of Dissolved Oxygen.	Ammonia.		Chlorine.	Organic Nitrogen by Kjeldahl Method.	Nitrogen as		Total Nitrogen. — (Organic Nitrogen by Kjeldahl Method.)	Oxygen Consumed.		Hardness.	Fats.
						Free.	Albuminoid.			Nitrates.	Nitrites.		Two Min.	Five Min.		
October 30, . . .	11.00 A.M.	-	55	1,015,000	19.9											
30, . . .	12.00 M.	8,058	56	875,000	20.0	2.8500	.7000	8.01	2.02	.17	.0340	4.56	4.20	7.90	15.0	9.1
30, . . .	1.00 P.M.	21,218	56	1,166,000	28.0											
30, . . .	2.00 P.M.	10,636	55	1,225,000	24.6											
30, . . .	3.00 P.M.	19,064	55	2,415,000	24.8	2.2500	.6200	8.81	1.58	.13	.0200	3.58	4.20	8.00	19.6	9.7
30, . . .	4.00 P.M.	15,887	55	2,065,000	18.4											
30, . . .	5.00 P.M.	13,055	55	1,785,000	25.3											
30, . . .	6.00 P.M.	11,472	54	210,000	33.0	1.8500	.4700	6.64	1.17	.13	.0300	2.85	2.20	4.40	11.8	2.4
30, . . .	7.00 P.M.	13,110	53	490,000	27.7											
30, . . .	8.00 P.M.	14,181	53	1,085,000	26.7											
30, . . .	9.00 P.M.	10,269	53	2,785,000	13.1	1.7500	.4800	6.91	1.30	.12	.0300	2.80	3.00	4.50	15.0	5.6
30, . . .	10.00 P.M.	10,269	53	875,000	30.0											
31, . . .	5.00 A.M.	64,467	53	1,785,000	43.4											
31, . . .	6.00 A.M.	9,500	54	2,730,000	38.5	0.4500	.1100	5.12	0.30	.19	.0200	0.88	0.80	0.90	9.4	1.2
31, . . .	7.00 A.M.	5,500	54	420,000	44.8											
31, . . .	8.00 A.M.	18,151	55	910,000	30.4											
31, . . .	9.00 A.M.	14,016	54	1,435,000	29.6	2.3500	.6800	6.55	2.31	.15	.0360	4.42	2.60	5.30	10.8	4.9
31, . . .	10.00 A.M.	17,472	54	595,000	22.9											
Average, . .	....	276,325*	54.3	1,325,888	27.8	1.9200	.5300	7.01	1.45	.15	.0283	3.19	2.83	5.16	13.6	5.5

* Total flow for twenty-four hours.

Table showing Comparison of Relative Amounts of Different Substances in Representative Sewage from the Several Places Aforesaid.

Nitrogen as Albuminoid Ammonia (Wanklyn), with Organic Nitrogen (Kjeldahl).

[Parts per 100,000.]

	Worcester State Lunatic Hospital.	Marlborough.	Framingham.	Lawrence Street Sewer.	Experiment Station.
Nitrogen as albuminoid ammonia (Wanklyn),	0.55	0.50	0.43	0.53	0.61
Organic nitrogen (Kjeldahl),	3.25	1.26	1.45	2.16	1.58
Per cent. which former is of latter,	17	39	30	25	38
Per cent. of dissolved oxygen,	69	45	28	63	0

Nitrogen as Free Ammonia, with Total Nitrogen (Kjeldahl).

Nitrogen as free ammonia,	0.77	1.94	1.57	1.35	2.81
Total nitrogen (Kjeldahl),	4.10	3.47	3.19	3.80	4.39
Per cent. which former is of latter,	19	56	49	36	64

Oxygen consumed, determined after boiling Two Minutes and Five Minutes.

Oxygen consumed after two minutes,	5.25	2.38	2.83	4.24	-
Oxygen consumed after five minutes,	9.30	3.62	5.16	7.05	-
Per cent. which former is of latter,	56	66	55	60	-

Total Nitrogen (Kjeldahl), with Oxygen consumed after Two Minutes.

Total nitrogen (Kjeldahl),	4.10	3.47	3.19	3.80	4.39
Oxygen consumed after two minutes,	5.25	2.38	2.83	4.24	5.22
Per cent. which former is of latter,	78	145	112	89	84

Total Nitrogen (Kjeldahl), with Chlorine.

Total nitrogen (Kjeldahl),	4.10	3.47	3.19	3.80	4.39
Chlorine,	3.93	6.73	7.01	5.79	9.17
Per cent. which former is of latter,	104	51	45	65	47

Total Nitrogen (Kjeldahl), with Fats.

Total nitrogen (Kjeldahl),	4.10	3.47	3.19	3.80	4.39
Fats,	5.1	2.7	5.5	-	-
Per cent. which former is of latter,	80	128	58	-	-

This last table shows the relative amounts of the different substances in the average sewage of each place. The average analysis of the Worcester Hospital sewage agrees very closely with the average analysis of the 1894 series. The number of inhabitants of the institution and the total flow of sewage for the day are also nearly identical for both years. With the Marlborough and Framingham sewages the amounts of these various substances are less in almost every instance in 1895 than they were in 1894. This difference is due to the fact that the total daily flow of sewage was greater on the day on which the series were taken in 1895 than it was in 1894. That is to say, the sewage, especially at Marlborough, was diluted by a much larger volume of ground water, owing to recent rains.

The chief points of the analyses to be noticed are that, as in 1894, the amount of organic nitrogen represented by the albuminoid ammonia is a comparatively small and variable per cent. of that found by the Kjeldahl method. This percentage is lowest where the sewage is freshest and the amount of dissolved oxygen highest; where the sewage is most stale, that is, where it has undergone the longest-continued chemical and bacterial action, the percentage is greatest. The percentage which the nitrogen, as free ammonia, forms of the total nitrogen, follows the same general rule.

Permanency of Sewage Filters.

The permanency of a sewage filter depends upon the maintenance of an equality between the amount of organic matter applied to the filter, and the amount purified and removed in the effluent or escaping into the air in the form of gas, plus the amount removed from the surface of the filter. If a limited area for filtration purposes is a necessity, there is of course more or less accumulation of organic matters upon the surface of the filter or within the upper few inches of the filtering material.

If the sewage is fresh when it flows upon the filter, the organic matter in suspension will not be finely divided and hence will strain out, remain upon the surface of the filter, and can be removed without removing much if any of the filtering material. This removal keeps the filter porous, in good condition, and the dry scum removed decomposes so slowly that it does not create a nuisance. On the other hand, if the sewage is stale when it flows upon the filtering

area, and the sludge or organic matter in suspension is finely divided by the comparatively long-continued mechanical, chemical and bacterial actions through which it has passed, a much larger percentage of this organic matter will pass into the interstices of the filtering material, and, if removed in any way except by being changed into the inorganic form and passing away in the effluent or escaping into the air in the form of nitrogen and carbon gases, a considerable portion of the surface layers of the filtering material will have to be removed also.

During the earlier years of the investigations at this station the sewage applied to the filters was comparatively weak, but fresh; and considerable trouble was experienced, caused by the clogging of the surface of the filters by the crude organic matters of the sewage; and comparatively poor purification was obtained at such times, because of the difficulty with which the sewage passed through these clogged surfaces, and also because of insufficient aëration from the same cause. During latter years the sewage applied to the filters has been stale, and, because of this and the consequent fine division of the sludge, there has not been so much clogging of the surface as formerly, and very little difficulty has been experienced in disposing of the prescribed daily dose of sewage. The sewage applied to the experimental filters contained, on an average, twice as much unoxidized nitrogen during 1895 as during most of the earlier years (see page 446), and hence, although the number of gallons per acre daily applied to the out-door filters has been largely reduced in some instances, the amount of organic matter applied has not been reduced much, if any. This stale organic matter has apparently been worked over to such an extent, during its slow passage through the pipe from the sewer to the station, that it is of a nature more easily attacked by the bacteria in the filter than was the former fresh organic matter. As a result of this, there has not been the steady increase of stored nitrogen and fats in the filters that formerly occurred. The amount of this stored nitrogen present fluctuates according to seasons of high or low nitrification.

Table showing the Amount of Nitrogen stored in the Sand of Filters Nos. 1 and 9 A at Different Periods, calculated from Determinations of Albuminoid Ammonia.

[Parts per 100,000 by weight of dry sand.]

Depth below Surface. (Inches.)	Filter No. 1.				Filter No. 9 A.		
	Jan., 1894.	Oct., 1894.	Oct., 1895.	March, 1896.	Jan., 1894.	Nov., 1894.	Oct., 1895.
6,	17.5	11.5	37.6	27.6	33.1	28.5	47.2
9,	17.7	13.9	24.4	20.0	16.5	22.9	9.2
12,	21.5	15.0	13.2	16.0	11.3	11.6	7.6
18,	21.0	13.8	8.6	10.0	8.3	8.0	6.0
24,	17.2	11.8	6.6	8.9	3.8	6.0	3.6
36,	5.9	4.9	3.6	5.9	2.6	4.0	2.4
48,	4.3	2.5	3.0	3.8	2.6	3.0	2.4
60,	3.0	1.8	2.0	3.4	1.8	1.8	2.4

In this table the amount of nitrogen in the upper six inches of filtering material is not given, as the method of spading over the surface of the filters to this depth at least twice each year makes accurate and representative determinations difficult to obtain; but the analyses made of the sand of this portion of the filters indicated that there was a smaller amount of stored nitrogen in the upper six inches of Filter No. 1 in October, 1895, than in October, 1894, and that the stored nitrogen in the upper six inches of Filter No. 9 A had increased but little, if any.

There has been no removal of clogged sand from any of the large outdoor filters at the station since 1893 (see pages 413 and 414 of report of 1893), and the weekly rakings to the depth of one inch, together with the spading over of the surface spring and fall, keep the filters in such condition that little difficulty is experienced from the inability of the applied sewage to pass below the surface of the filter.

The actual number of gallons of sewage applied to the large filters, one two-hundredth of an acre in area, from their date of construction up to Jan. 1, 1896, is given in the following table: —

Filter Number.	Date when Sewage was First Applied.	Actual Number of Gallons Applied.	Gallons per Acre.
1,	Jan. 10, 1888,	1,077,000	215,400,000
2,	Dec. 19, 1887,	499,300	99,860,000
4,	Dec. 19, 1887,	362,400	72,480,000
5,	Sept. 14, 1891,	605,400	121,080,000
6,	Jan. 12, 1888,	664,000	132,800,000
9 A,	Nov. 18, 1890,	663,700	132,740,000

Resting.

With the idea of securing the removal of nitrogen from the surface layers of the large outdoor filters, they were allowed to rest during a large portion of the months of October and November, 1894. The weather was very cold for these months, and this prolonged resting resulted in destroying active nitrification in these filters, and as a result the purification obtained by them during the ensuing winter was very poor. Profiting by this experience, the filters were allowed to rest for short periods only, and during warmer weather in October and November, 1895.

It is very doubtful if any resting, except during warm weather, when nitrification is active, is effective in removing nitrogen, but it gives the filter a chance to drain and the top layers of material to dry.

Effect of Winter Weather.

The first effect of winter weather is the diminution of the activity of the nitrifying organism. This causes the nitrates of the effluent to become low and increases the quantity of free and albuminoid ammonia. If the sewage applied to the filters does not contain an excessive amount of sludge, or organic matters in suspension, it can be applied in such volume as to keep the filter comparatively free from frost; when sludge is present in large quantity, however, a large volume of sewage will tend to clog the surface of the filter by the deposition of this sludge upon the surface. With the concentrated sewage now pumped at the station, a sewage much stronger than the average of the twenty-four hours' flow in the Lawrence Street sewer, this difficulty is quite a factor in the management of the filters. Where settling basins and sludge beds are in operation this difficulty can be, in a measure, overcome.

Average Purification of Sewage by the Several Filters in 1895.

The following table gives the average results obtained by the several filters during 1895. The qualitative efficiency of the filters is shown by the percentage removal of organic matter of the applied sewage, as indicated by the albuminoid ammonia and oxygen consumed: —

Average Per Cent. of Albuminoid Ammonia, Oxygen consumed and of Bacteria removed from Sewage by the Several Filters, with Average Rates of Filtration, 1895.

Number of Filter.	Depth of Sand (Inches).	Mean Diameter (Inches).	Area in Fractions of an Acre.	Size of Sand.		Manner of Filling.	In Operation Since	Average Rate of Filtration (Gallons per Acre) Daily.	Average Per Cent. Removed of		
				Effective Size in Millimeters (10 Per Cent. Finer than)	Uniformity Coefficient.				Albuminoid Ammonia.	Oxygen Consumed.	Bacteria.
1,	63	200	$\frac{1}{200}$	0.48	2.4	Wet.	Jan. 10, 1888.	67,000	89	86	97.55
2,	60	200	$\frac{1}{200}$	0.08	2.0	Wet.	Dec. 19, 1887.	34,000	97	95	99.98
4,	60	200	$\frac{1}{200}$	0.04	2.7	Wet.	Dec. 19, 1887.	15,000	98	96	99.99
5 A,	63	200	$\frac{1}{200}$	1.40	2.4	Dry.	Sept. 14, 1891.	66,000	85	83	94.50
6,	44	200	$\frac{1}{200}$	0.35	7.8	Wet.	Jan. 12, 1888.	56,000	90	89	99.10
9 A,	60	200	$\frac{1}{200}$	0.17	2.0	Dry.	Nov. 18, 1890.	66,000	90	89	98.70
10,	60	200	$\frac{1}{200}$	0.35	7.8	Dry.	July 18, 1894.	30,000	94	90	99.50
15 B,	65	20	$\frac{1}{20000}$	5.10	2.0	Dry.	July 25, 1892.	449,000	83	76	89.00
16 B,	65	20	$\frac{1}{20000}$	5.10	2.0	Dry.	July 25, 1892.	465,000	85	80	84.00
21 A,	60	20	$\frac{1}{20000}$	1.60	2.4	Dry.	March 19, 1894.	340,000	87	83	92.30
22 A,	60	20	$\frac{1}{20000}$	Coke.	-	Dry.	March 19, 1894.	336,000	91	90	94.50
51,	60	50	$\frac{1}{3000}$	5.30	2.4	Dry.	Feb. 1, 1895.	608,000	63	52	77.00
52,	60	50	$\frac{1}{3000}$	Coke.	-	Dry.	Feb. 1, 1895.	608,000	74	67	83.50
59,	60	30	$\frac{1}{10000}$	2.50	2.0	Dry.	April 1, 1895.	520,000	75	70	77.00

Removal of Sludge from the Sewage.

As the experiments have continued with the consequent accumulation of data concerning the strength and composition of sewage, it has become evident that the sewage pumped at the station and applied to the experimental filters has been stronger during 1895 than the average sewage flowing through the Lawrence Street sewer, and stronger than any sewage treated at the filtration areas at different places in the State. As a matter of fact, the sludge is generally settled out to a considerable extent at the filtration areas, and applied to separate beds. This method has its advantages, as it concentrates the sludge, and keeps a large amount of clogging material from flowing upon the regular filtration beds. This is especially advantageous in winter, as has been mentioned before. Its disadvantages are, that the sludge, so concentrated, is much more offensive than when allowed to flow upon the filtration areas as rapidly as possible, and become exposed in thin layers to the air. In cold weather, however, the accumulation of sludge is less offensive than in warm weather. Studies of different methods of removing sludge from sewage have been continued throughout the year, as follows: —

1. Rapid filtration through coarse gravel, with the aid of a current of air drawn down through the gravel.
2. Rapid filtration through coarse gravel, with the aid of a current of air forced up through the gravel.
3. Rapid filtration through medium coarse coke, with a current of air forced up through the coke.
4. Sedimentation.
5. Chemical precipitation.
6. Straining through coke.

The percentage removal of organic matter, as indicated by the albuminoid ammonia and the oxygen consumed, and of the bacteria, is shown by the following table: —

Table showing Purification of Sewage by Different Methods of removing Sludge.

Method.	Number of Filter.	Effective Size of Sand.	Uniformity Coefficient.	In Operation since	Percentage Removed of — Albuminoid Ammonia.	Oxygen Consumed.	Bacteria.
Rapid filtration through coarse gravel, with the aid of a current of air drawn down through the gravel.	15	5.40	2.0	July 25, 1892.	83	76	89
	16	5.40	2.0	July 25, 1892.	85	80	84
	21	1.60	2.4	March 19, 1894.	87	83	92
	59	2.50	2.0	April 1, 1895.	75	70	77
Rapid filtration through coarse gravel, with the aid of a current of air forced up through the gravel.	51	5.30	2.4	Feb. 1, 1895.	63	52	77
Rapid filtration through medium coarse coke, with a current of air forced up through the coke.	52	Coke	-	Feb. 1, 1895.	74	67	83
Sedimentation, ...	-	-	-	- -	48	34	31
Chemical precipitation, ...	-	-	-	- -	63	53	61
Straining through coke, ...	-	-	-	- -	54	45	54

Comparison of the Several Methods.

The first method mentioned has been under investigation at the station for several years, and has been exhaustively discussed in the reports of the Board. It is a scientific success, and perhaps, under favorable conditions, could be used practically. The method of aërating the filters at the station is exceedingly costly, as compared with the results secured. The aspirators attached to filters Nos. 15 and 16 are operated with the entire head or pressure of the city water supply, and will, when attached to a tube of mercury, draw the mercury to a height that shows their power to produce very nearly a vacuum. This gives a power sufficient to draw air through the filters of coarse gravel, even when they are very badly clogged with organic matter. These two filters have received sewage at an average rate of about 450,000 gallons per acre daily, and have removed from it the very large percentage of organic matter shown by the table. This organic matter has been largely oxidized or burned up, but not by any means completely, over 20 per cent. of that applied during 1895 being stored in each filter. This storage of organic matter causes sooner or later such a clogging of the filter and poor purification that it must be removed, or the life of the

filter is ended. Removal by continuous aëration without application of sewage to the filter is a slow and incomplete method, and, if the gravel be removed and washed, the labor is considerable and the volume of water used very large.

Forcing Air up through the Filter.

On Feb. 1, 1895, an experiment was begun to test the value, estimated by percentage removal of sludge, of filtering sewage through some coarse media at high rates, aided by a current of air forced up through the filtering material.

For this purpose two filters of equal size were constructed, one containing 60 inches in depth of coarse gravel of an effective size of 5.30 millimeters, and the other with the same depth of coke breeze, from which the finer particles had been removed. The outlets of these filters were trapped, and down through the centre of each a pipe was passed, reaching to within 6 inches of the bottom of the filter. To these pipes a fan blower was attached, driven by electric power, the idea being to carry the air to the under-drains of each filter, where it would pass out into the under-drains and be forced up through the interstices of the filtering material. These filters have received sewage at an average rate, during their period of operation, of 608,000 gallons per acre daily. The blowing apparatus used created a current of air that was capable, under the most favorable circumstances and with the fan making 3,600 revolutions per minute, of holding up a column of mercury nearly 3 inches. With the connections and elbow joints necessary to carry the air to the point desired, the force of the current was reduced to one-third of this. During the period of operation of these filters this current of air was never strong enough to move pieces of paper laid upon the surface of the filters, and was only occasionally strong enough to be felt by placing the hand upon the surface. When the surface became badly clogged, the force of the current generated by the open-sided blower was apparently only strong enough to keep a steady pressure of air against the under side of the clogged surface layers of the filter, and there was a constant current of air from the open sides of the blower. The filters used in this experiment were numbered 51 and 52.

Filter No. 51. — This filter, one three-thousandth of an acre in area, contained 60 inches in depth of gravel of an effective size of

5.30 millimeters. It received sewage during the period of its operation at an average rate of 608,400 gallons per acre daily, and its effluent contained on an average 37 per cent. of the organic matter of the applied sewage, as shown by the albuminoid ammonia determinations, and 23 per cent., as shown by the determinations of oxygen consumed. Two and eighty-one one-hundredths pounds of organic nitrogen were applied to the filter, 1.15 pounds of organic nitrogen passed away in the effluent, and 0.27 of a pound remained stored in the filter at the close of the experiment. (For details of operation, see page 491.)

Filter No. 52. — This filter was of the same depth and area as Filter No. 51, but contained, instead of gravel, coke breeze from which the finer particles had been removed. It was operated in the same manner as Filter No. 51, and received during its period of operation the same volume of sewage. It was a more efficient filter in removing organic nitrogen from the applied sewage than Filter No. 51, but this nitrogen was stored in the filter, as shown by the fact that nitrification was lower than in Filter No. 51. This removal of sludge from the applied sewage was aided by the exceedingly rough surfaces of the pieces of coke.

Disposal of Effluents of Filters Nos. 51 and 52. — The effluents of filters Nos. 51 and 52 were, for the comparison of results obtained, each divided into three portions, and applied equally to filters of equal depth and area, but containing different filtering materials; that is, the effluent of Filter No. 51 was applied to Filter No. 53, one twenty-thousandth of an acre in area and containing 60 inches in depth of sand of an effective size of 0.19 millimeter; to Filter No. 55, of the same area and depth, but containing sand of an effective size of 0.40 millimeter; and to Filter No. 57, containing 60 inches in depth of coke breeze. The effluent of Filter No. 52 was applied to three similar filters, — filters Nos. 54, 56 and 58.

The results obtained by this double filtration were not as good as the results obtained by the filters 15 B, 16 B, 12 A combination, as shown by the next table, owing to the comparatively poor purification obtained in filters Nos. 51 and 52. There was no appreciable difference in the operation of these filters, and the qualitative results obtained were very similar, as shown by the table.

The amount of nitrogen stored in the sand filters at the close of the experiment, calculated from albuminoid ammonia determinations, was as follows: —

[Parts per 100,000 by weight of dry sand.]

Depth below Surface (Inches).	Filter No. 53. Effective Size, 0.19.	Filter No. 55. Effective Size, 0.40.	Filter No. 54. Effective Size, 0.19.	Filter No. 56. Effective Size, 0.40.
0-6,	72.7	58.4	76.1	58.9
9,	14.9	20.7	24.4	17.9
12,	9.2	12.0	10.8	13.9
18,	5.9	7.4	9.8	8.5
24,	6.1	4.9	4.9	5.6
36,	3.6	4.0	5.0	3.9
48,	3.1	4.3	2.6	3.4
60,	2.0	4.3	2.0	3.1

Sedimentation.

At many sewage disposal areas the sewage is allowed to pass through settling tanks, in order that as large an amount of the sludge as possible may settle out; the supernatant liquor then flows to the disposal areas and the sludge to specially prepared sludge, beds. The amount of sludge removed by this method varies with the character and strength of the sewage.

During 1892 the continuous experiment at the station showed a removal of 18 per cent., and during 1895 of 48 per cent., of sludge, as indicated by the total albuminoid ammonia. The sewage of the latter year contained much more sludge than the sewage of the former year. A larger percentage of the sludge can generally be removed from fresh sewage than from stale sewage in which the sludge is more finely divided. (For results upon the removal of sludge, see pages 450 and 451.)

Chemical Precipitation.

The percentage removal of sludge by means of the addition of chemicals to the sewage, and subsequent sedimentation, depends upon the same factors as in the removal of sludge by sedimentation alone. In both cases the result is a concentration of the sludge in a smaller body of liquid. This resulting concentrated sewage, in volume generally at least one-fourth the original volume, remains to be disposed of. (For results upon chemical precipitation, see pages 450 and 451.)

Straining through Coke.

By straining sewage through coke we have removed, during 1895, 54 per cent. of the sludge (total albuminoid ammonia) of the sewage. The sewage has been strained at an average rate of 1,000,000 gallons per acre daily, and the coke strainer has contained from 6 to 8 inches in depth of coke. The coke used is known as breeze, and is the screenings from commercial coke. At the Lawrence gas house, where it is obtained, it is used under the boilers, and called worth one-fourth as much as the steam coal or from $1.00 to $1.25 per ton; the amount used has been equal to 10 cubic yards per 1,000,000 gallons of sewage strained, and, as a ton of coke contains about 2.3 cubic yards, the sewage has been purified, to the extent given, at a cost for coke of $5.43 per 1,000,000 gallons of sewage strained, calling the coke worth $1.25 per ton.

By this method of straining we remove the sludge from the entire body of liquid, and get rid of the concentrated sludge liquor which is a result of sedimentation and chemical precipitation; and it seems probable that the coke is as valuable for combustion after use in the strainer as before.

The following table shows the qualitative and quantitative purification obtained by these different methods for removing sludge, followed by filtration, during 1895: —

Table showing Total Purification of Sewage by Filtration and a Preliminary Treatment to remove Sludge.

Method.	Number of Filter.	Size of Sand.		Average Rate (Gallons per Acre Daily, Six Days a Week).	Percentage removed of		
		Effective Size in Millimeters Ten Per Cent. finer than	Uniformity Coefficient.		Albuminoid Ammonia.	Oxygen Consumed.	Bacteria.
By rapid filtration through gravel, aided by a current of air and filtration through sand (filters No. 15 and No. 16).	12 A	.19	2.0	614,000	.97	.94	99.7
By sedimentation and filtration through sand, . .	13 A	.19	2.0	160,000	.95	.91	99.6
By chemical precipitation and filtration through sand,	19	.17	2.0	200,000	.97	.95	99.9
By straining through coke and filtration through sand,	14 A	.19	2.0	320,000	.96	.94	99.8
By rapid filtering through gravel, aided by a current of air (Filter No. 51) and filtration through sand or coke.	53	.19	2.0	681,000	.93	.91	72.3
	55	.40	2.4	667,000	.91	.88	68.5
	57	coke.	-	704,000	.92	.90	77.9
By rapid filtration through coke, aided by current of air (Filter No. 52) and filtration through sand or coke.	54	.19	2.0	668,000	.95	.93	68.5
	56	.40	2.4	695,000	.93	.91	-
	58	coke.	-	702,000	.94	.93	74.8

Comparison of Resulting Liquids.

Comparing the resulting liquids after the treatment of sewage by these various methods of removing sludge, it is noticeable that the organic matter in the liquids after rapid filtration combined with aëration is of a different character from the organic matter in the sewage resulting from the other sludge-removing processes. That is to say, even when the organic matter, as shown by the albuminoid ammonia, is present in quantities as great as in the other partially purified sewages, it has passed through such chemical and biological changes that it develops offensive odors very slowly on standing.

The Disposal of Waste Liquors from Industrial Works.

Investigations upon the disposal of waste liquors from the processes of paper making, wool scouring and tanning have been begun.

Paper Making.

All rags are cleaned before being made into paper by being boiled in a solution of caustic soda, caustic lime, or a mixture of soda ash and lime, to free them from grease, dirt and coloring matters. The resulting liquor is very highly polluted with organic matter and when discharged into a small body of water may create a nuisance. On September 8, a filter was started to see if this waste liquor could be purified by filtration through sand. The liquor applied to the filter is very alkaline, and the results obtained indicate that while a considerable purification may be obtained by filtration through sand, yet the organic matter present is of a nature not easily attacked by the bacteria in the filter and the degree of alkalinity obtained is unfavorable for the growth of the nitrifying bacillus. (For results obtained see page 501.) When, however, this liquor is diluted by the large volume of wash water used in paper making, the resulting dirty water or sewage can in most cases probably be easily purified by filtration. The volume of wash water is very large.

Wool Scouring.

The condition of wool when first obtained from the sheep's back is such that mordanting and dyeing without removal of the grease, dirt, etc., would be impossible. Besides the mechanically held dirt

the impurities are of a two-fold character, the "wool fat," soluble in ether, and the "wool perspiration," soluble in water. The two are frequently included under the name of the "yolk" or "suint" of the wool.

Wool fat is not a fat as commonly understood, that is, it is not a glycerate. By treating it with boiling alcohol it may be separated into two portions, one soluble and the other insoluble in this liquid. The soluble portion consists mainly of cholesterine and isocholesterine, together with compounds of these bodies with organic acids. The insoluble portion consists mainly of cholesterine and isocholesterine with oleic and fatty acids. Grease and dirt are present on the wool to such an extent that different wools lose from 15 to 75 per cent. by weight in passing through the washing, scouring and rinsing processes. It is the common method to remove these impurities by solutions of alkaline carbonates and soaps. In the centres of the French and Belgian woollen industries the wool is first washed with water, the solution evaporated, and potassium carbonate recovered. This potassium carbonate may be present to the amount of 4 per cent. of the weight of the raw wool. In this country little if anything is done towards recovering the potash salts, the preliminary treatment with water being generally dispensed with. In many places abroad the waste scouring liquors are collected in stone-lined pits and neutralized or acidified by sulphuric acid, and the fatty matters, which rise to the surface, are collected in filter bags and sold. This of course causes a partial purification of the liquor, but all the dirt and a considerable portion of the fatty matter still remain in it. There are very few places in this country, however, where even this partial purification is undertaken, the waste liquor in its entirety being allowed to run into and pollute the neighboring stream. A process of wool cleansing, growing in favor, is one by which the fatty matters are first removed by naphthalene or gasoline and the remaining dirt subsequently removed by the usual scouring process, the fat removed by the first process being a valuable by-product.

Careful calculations have shown that the volume of water used in a wool-scouring plant is about 100 gallons per pound of wool scoured; a small and varying proportion of this volume being directly used in the scouring bowls and the remainder being used for rinsing the wool after scouring.

Beginning September 8, the strong waste liquor from the scouring process has been applied to a filter containing 5 feet in depth of sand

of an effective size of 0.25 millimeter. The rate of application has been equal to about 17,000 gallons per acre daily, and the results so far obtained have made clear that while this liquor can be filtered through sand and a considerable portion of the organic matters removed, yet it is with such difficulty and at such low rates in gallons per acre daily that a preliminary treatment, to remove a large part of the dirt and fatty matters before filtration, is essential. Subsequent filtration of the effluent of this filter improves it little if any, the character of the organic matter and the degree of alkalinity of the original liquor and the effluent being such that the bacteria attack it very feebly. The numbers of bacteria in the liquor and in the effluent are enormous, but the nitrifying bacillus does not seem to develop and the organic impurities are apparently of such a stable character that decomposition and putrefaction take place very slowly.

Removal of Fats and Dirt before Filtration.

As already mentioned, a certain portion of the fats present in the wool liquor can be collected by the addition of sulphuric acid to the liquor, but a more complete removal of the fats and dirt can be effected by the addition of calcium chloride. This precipitates the fat as a lime soap and the precipitate carries down with it all the dirt in suspension in the liquid, leaving a clear but highly colored solution. It seems probable, and experiments are now under way to test the fact, that, by hot pressing this precipitate, enough fat may be obtained to make the process pay for itself. The clarified liquor is rich in organic matters in solution but they are of the same stable character as before mentioned and pass through 5 feet of sand with very little change.

Tannery Sewage.

In connection with the investigations in regard to the condition of the Neponset River two experimental filters have been operated at Norwood, Mass., to determine the feasibility of purifying, by filtration through sand, the waste liquors from preparing and tanning hides.

A filter was constructed containing 2 feet in depth of sand, of an effective size of 0.14 millimeter, over gravel under-drains. It was not feasible to have at the place desired a filter with a greater depth of sand, owing to the slope of the land and the necessity of having the sewage run on to the filter by gravity and away from the under-drains in the sewer which carries the tannery sewage to the river.

Sewage was first applied to this filter September 27. The sewage is a mixture of the waste liquors from all the processes carried on in the tannery, and it has been applied to this shallow filter at an average rate of 55,000 gallons per acre daily, and with the results given below.

Table showing Average Analyses of Sewage applied to and Effluent from the Filter.

[Parts per 100,000.]

	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as		Oxygen Consumed.
				Nitrates.	Nitrites.	
Sewage,	3.1000	3.1600	312	.1600	.0015	55.00
Effluent,	2.3400	.6000	290	1.0500	.0100	7.50

The sewage is very strong and offensive, being highly charged with decaying animal tissues and the bran added to cause fermentation to take place. It is also highly colored by the different aniline dyes used in coloring the hides, and these coloring matters, after the first few weeks of operation of the filter, failed to be completely removed. The sewage applied to the filter has been almost entirely that resulting from the preparation of the hides, the spent tan liquor forming but a very small proportion of the waste liquors flowing from the tannery. It need hardly be said that tannic acid if applied in any quantity would be very prejudicial to decomposition and nitrification in the filter.

Precipitation with Lime.

In one of the processes at the tannery a large amount of lime is used, and in consequence of this, there is an almost continuous stream of lime water flowing into and mixing with the remainder of the sewage ; and it is evident that, if settling tanks were properly arranged, and the flow of lime water regulated, a large percentage of the sludge could be precipitated out. Preliminary experiments have shown that probably 60 per cent. of the organic matter can be removed in this way, but the resulting supernatant sewage is very rich in organic matter in solution.

A small filter, to which this supernatant sewage is applied at an average rate of 120,000 gallons per acre daily, was started toward the end of the year, and is at the present time, July, 1896, in a

state of active nitrification and giving a clear almost odorless effluent. These experiments have demonstrated that this sewage can be purified by filtration.

Work of the Filters for 1895.

The experimental filters in operation during 1895 have included all in operation at the end of 1894, together with the addition of filters Nos. 51, 52, 53, 54, 55, 56, 57, 58, 59, 60 and 61. Filters 1 to 10 inclusive are out of doors, and are each one two-hundredth of an acre in area; filters 12 to 61 inclusive are within the buildings and are one twenty-thousandth of an acre in area, with the exception of Filter No. 59, which is one ten-thousandth of an acre in area, and filters Nos. 51 and 52, which are one three-thousandth of an acre in area.

Filter No. 1.

This filter, containing 60 inches in depth of coarse sand of an effective size of 0.48 millimeter, was purifying sewage very poorly at the beginning of the year, owing to the destruction of nitrification by too long continued resting during the cold weather of October and November, 1894. This poor purification continued throughout January and February, and not until the middle of March did the effluent begin to show good oxidation and nitrification in the filter. Observations were made daily during this period of the presence of frost, and efforts made to re-establish nitrification by picking holes in the surface of the filter, to allow the sewage to pass more rapidly below the surface, and by seeking to remove frost by the application of large doses of sewage.

On January 25 the filter was covered with two thicknesses of canvas stretched over a frame, as in previous years, and this cover was removed March 13. On March 23 the surface was spaded over (corresponding to ploughing) to a depth of 4 inches. Good results were obtained from the first of April throughout the remainder of the year. August 20 the surface was raked (corresponding to harrowing) to a depth of 3 inches and on October 22 and November 9 it was spaded over to a depth of 6 inches. On November 15 it was covered for the winter with canvas stretched over a frame. The quantity of sewage applied to the filter was at the rate of 80,000 gallons per acre daily during the first half of the year and 60,000 gallons per acre daily during the last half of the year.

The monthly averages of the weekly analyses of the effluent of this filter are presented in the next table.

Monthly Averages of Analyses of Effluent of Filter No. 1.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	84,400	47	37	4h. 19m.	Decided.	.77	3.7000	.2660	9.49	0.26	.0960	1.79	211,000
February, .	80,000	49	38	1h. 52m.	Decided.	.54	2.4875	.1675	8.99	1.09	.3500	1.17	88,200
March, .	76,900	44	40	1h. -	Decided.	.83	2.1375	.2350	10.39	1.25	.2905	1.96	177,000
April, . .	55,400	47	43	8m.	Decided.	.33	.4600	.0867	10.84	2.64	.2833	0.97	85,000
May, . .	80,000	59	57	4m.	Slight.	.19	.0222	.0261	12.86	3.28	.0053	0.28	23,000
June, . .	83,200	69	66	2m.	Slight.	.17	.0830	.0350	15.59	4.88	.0100	0.31	22,000
July, . .	77,000	69	71	3m.	V. slight.	.14	.0755	.0240	14.63	4.10	.0026	0.23	27,800
August, .	56,600	70	74	3m.	Slight.	.13	.0537	.0236	14.06	3.70	.0018	0.25	33,000
September,	60,000	67	72	2m.	None.	.11	.0564	.0211	15.61	4.25	.0025	0.19	3,700
October, .	45,500	56	59	5m.	None.	.13	.1148	.0248	12.24	2.92	.0014	0.25	15,540
November, .	49,600	62	52	19m.	V. slight.	.16	.4510	.0380	7.91	1.86	.0467	0.44	41,500
December, .	60,000	53	47	49m.	Decided.	.30	1.0250	.0680	8.25	1.92	.1100	0.47	63,000

Sewage applied, 400 gallons six times a week, January 1 to March 31; 200 gallons twelve times a week, April 1 to July 31; 300 gallons six times a week, August 1 to 18; 150 gallons twelve times a week, August 19 to October 21; 150 gallons three times a week, October 22 to 31; 150 gallons twelve times a week, November 1 to December 31. Tank covered with canvas January 25 to March 13, and November 15 to December 31. April 11 to 20, experiment interrupted by freshet. Trap attached to outlet June 19 to July 3, and a trap 18 inches high August 31 to September 27. September 9, trap turned down and effluent pipe flushed out. August 31, white worms found in under-drains, and under-drains flushed out. Surface raked about 1 inch deep each week except twice in February and once in April. Surface dug over 4 inches deep March 23; 3 inches deep August 20 and December 27; 6 inches deep October 22 and November 8. During January, 8½ inches of snow and 3¾ inches of ice removed from surface; during March, 2¼ inches of snow and ½ inch of ice removed.

Filter No. 2.

This filter, containing 60 inches in depth of fine sand of an effective size of 0.08 millimeter, trenched with medium fine sand of an effective size of 0.19 millimeter, had, at the beginning of the year, begun to feel the effects of the prolonged resting during the cold weather of October and November, 1894. The effluent of the filter continued to be of a poor quality during January, February and March, but during April the nitrates were much higher, although the free ammonia was still high. From the beginning of May throughout the remainder of the year the filter was in good condition and the effluent of a satisfactory quality. During the first two months of the year the sewage applied to the filter disappeared

below the surface very slowly, and from February 8 to 18 the trenches remained partially covered with sewage and none was applied. The average rate of application of sewage during these two months was 18,000 gallons per acre daily. During the remainder of the year the approximate rate of application was 38,000 gallons per acre daily. On March 25 the sand of the trenches was removed, the sides of the trenches raked, the fine sand at the bottom of the trenches spaded over 3 inches deep and the sand of the trenches replaced. On September 9 this operation was repeated. The results for the year are shown by the monthly averages of the weekly analyses.

Monthly Averages of Analyses of Effluent of Filter No. 2.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	22,500	48	38	12h. -	None.	.08	1.2440	.0288	7.59	1.40	.0354	.30	1,540
February, .	13,400	46	36	12h. -	None.	.10	0.9867	.0380	7.88	0.70	.0039	.37	1,940
March, .	34,100	46	37	2h. 3m.	None.	.17	2.2350	.0675	8.19	0.36	.0213	.67	2,765
April, . .	27,700	48	42	28m.	None.	.15	1.9000	.0507	7.22	2.10	.0350	.37	89
May, . .	40,000	57	54	25m.	None.	.08	0.4450	.0250	8.53	3.24	.0009	.20	38
June, . .	41,600	68	61	7m.	None.	.09	0.0121	.0179	11.17	4.09	.0001	.17	38
July, . .	38,500	69	68	7m.	None.	.08	0.0009	.0154	14.86	3.60	.0001	.12	7
August, .	38,500	69	70	9m.	None.	.06	0.0009	.0134	13.95	3.74	.0001	.09	39
September, .	40,000	66	70	14m.	None.	.05	0.0008	.0156	13.98	3.54	.0003	.10	60
October, .	31,100	55	58	55m.	None.	.06	0.0019	.0120	14.68	4.21	.0002	.30	14
November, .	35,400	63	53	1h 55m.	None.	.07	0.0130	.0143	8.36	3.10	.0002	.10	5
December, .	41,000	54	42	8h. 31m.	None.	.09	0.0628	.0166	7.85	1.94	.0009	.15	11

Sewage applied, trenches were filled six times a week January 1 to March 26, except three days in January and eleven days in February. Amount of applied sewage varied from 40 to 190 gallons; 200 gallons six times each week, March 26 to October 22; 100 gallons three times a week, October 23 to 31; 200 gallons six times a week, November 1 to December 31. April 11 to 20, experiment interrupted by freshet. March 25, sand removed from trenches; sides of trenches raked; bottoms of trenches dug over 3 inches deep; sand thoroughly mixed and replaced in trenches. August 31 to September 6, a trap 18 inches high attached to outlet. September 9, grass and weeds removed from surface of tank; sand removed from trenches; bottoms and sides of trenches scraped and dirty sand piled on middle of tank; sides of trenches raked, and bottoms of trenches dug over 4 inches deep; sand thoroughly mixed and replaced in trenches. Surface of trenches raked 1 inch deep each week, except two omissions in February and one in April. October 22, surface of trenches dug over 3 inches deep. During January, 12½ inches of snow removed from entire surface, 9⅞ inches of ice from outer trench, and 5¾ inches from inner; during February, ½ inch of snow removed from surface, 4¾ inches of ice from outer trench and 8 inches from inner; during March, 5 inches of snow removed from surface; during December, 8 inches of snow removed from surface, 1¾ inches of ice from each trench.

Filter No. 4.

This filter, of fine river silt of an effective size of 0.04 millimeter and containing two trenches of coarse sand of an effective size of 0.48 millimeter, was giving an effluent of a good quality at the beginning of the year, but its surface was in poor condition and disposed of the applications of sewage with difficulty, the average

rate of filtration being only 7,000 gallons per acre daily for the first three months of the year, and from February 6 to 18 inclusive no sewage was applied to the filter. For the remainder of the year the average rate of filtration was 18,300 gallons per acre daily. The nitrates in the effluent were the lowest during March and April, but the ammonias were also low. On March 27 the sand of the trenches was removed, the sides of the trenches raked, the fine sand at the bottom of the trenches dug over to the depth of 3 inches and the coarse sand replaced. This treatment was repeated September 7, at which date a small amount of the dirty sand at the bottom of the trenches was removed and placed upon the surface of the filter. The quality of the effluent was quite satisfactory throughout the year, as shown by the following table, giving the monthly averages of the weekly analyses : —

Monthly Averages of Analyses of Effluent of Filter No. 4.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	7,500	47	43	15h. -	None.	.09	.0006	.0086	7.33	1.71	.0000	.14	8
February, .	4,600	48	43	14h. -	None.	.11	.0010	.0090	7.40	1.47	.0000	.17	90
March, .	9,000	45	42	12h. 38m.	V. slight.	.12	.0008	.0278	7.93	0.71	.0001	.23	2,560
April, .	18,000	47	41	17m.	V. slight.	.18	.0252	.0595	7.44	0.76	.0061	.34	597
May, . .	19,300	59	55	5m	None.	.20	.1034	.0319	5.96	1.73	.0025	.29	84
June, . .	20,800	68	61	2m.	None.	.14	.1412	.0162	9.10	3.05	.0085	.19	20
July, . .	19,300	69	69	3m.	None.	.12	.1380	.0189	11.62	2.39	.0049	.19	39
August, .	20,700	69	71	8m.	None.	.11	.0039	.0145	12.93	2.43	.0005	.18	61
September,	17,600	66	71	5m.	V. slight.	.10	.0063	.0137	13.86	2.54	.0012	.18	44
October, .	16,300	56	61	50m.	None.	.08	.0011	.0091	13.32	3.47	.0001	.12	272
November,	16,900	62	54	1h. 46m.	None.	.08	.0009	.0094	9.44	2.57	.0000	.10	31
December,	20,000	53	48	33m.	None.	.09	.0009	.0092	6.60	1.84	.0000	.12	23

Sewage applied, trenches filled three times a week, January 1 to March 29, except two days in January, six days in February, and three days in March. Quantity of applied sewage varied from 40 to 190 gallons; 200 gallons three times a week, March 30 to October 21; 100 gallons three times a week, October 22 to November 1; 200 gallons three times a week, November 2 to December 31. April 11 to 20, experiment interrupted by freshet. August 31 to September 6, a trap 18 inches high attached to outlet. March 27, sand removed from trenches; sides of trenches raked and bottoms of trenches dug over to a depth of 3 inches; sand thoroughly mixed and replaced in trenches. September 7, grass and weeds removed from surface of tank; sand removed from trenches; bottoms and sides of trenches scraped and dirty sand piled on middle of tank; sides of trenches raked and bottoms dug over 4 inches deep; sand thoroughly mixed and replaced in trenches. Surface of trenches raked 1 inch deep once in January, not at all in February, three times in March, and once each week during the remainder of the year. October 22 and December 27, surface of trenches dug over 3 inches deep. During January, 12½ inches of snow removed from entire surface, 12½ inches of ice from outer trench, and 7½ inches of ice from inner; during February, 2 inches of snow removed from surface, 10 inches of ice from outer trench and 5 inches from inner; during March, 4 inches of snow removed from surface, 1 inch of ice from outer trench and ½ inch from inner; duriug December, 8 inches of snow removed from entire surface.

Filter No. 5.

This filter, of fine gravel stones of an effective size of 1.40 millimeters, took the applied sewage without difficulty at an average rate of 76,000 gallons per acre daily during the first three months of the year, but the effluent was, until the middle of March, of a very poor quality, owing largely to the destruction of nitrification toward the end of 1894. From the middle of March until the end of the year the effluent was of as good a quality as could be expected from a filter of this coarse material entirely under-drained and only 5 feet in depth. The free ammonia of the effluent was high throughout the year, a natural result of the quick passage through the filter of sewage very high in free ammonia. The filter was spaded over to the depth of 4 inches March 4, raked 3 inches deep August 21, and spaded to a depth of 6 inches October 22. The results of the monthly averages of the weekly analyses are given in the following table: —

Monthly Averages of Analyses of Effluent of Filter No. 5.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	74,000	41	40	8h. 13m.	Decided.	.71	3.5700	.2380	9.01	0.63	.0133	1.32	339,000
February, .	73,300	41	35	7h. -	Decided.	.80	2.7250	.2250	9.28	0.93	.0185	1.42	137,000
March, .	80,000	40	39	19m.	Great.	.60	1.2000	.2100	7.04	2.19	.0312	1.38	163,000
April, . .	80,000	47	43	2m.	Decided.	.35	0.4167	.1260	9.76	2.71	.0090	0.79	88,000
May, . .	80,000	58	59	4m.	Decided.	.35	0.3050	.0740	13.96	2.87	.0033	0.60	215,000
June, . .	83,200	69	70	2m	Decided.	.33	0.6350	.0860	14.78	3.76	.0260	0.60	145,000
July, . .	77,000	69	71	3m.	Decided.	.30	0.4600	.0640	15.39	3.97	.0065	0.40	147,000
August, .	55,500	71	75	3m.	Decided.	.30	0.5687	.0927	14.08	2.90	.0110	0.58	186,000
September,	60,000	67	71	2m.	Slight.	.14	0.1550	.0260	15.02	3.55	.0086	0.26	28,000
October, .	44,400	55	58	14m.	Slight.	.18	0.4884	.0502	10.72	3.06	.0118	0.39	47,000
November,	53,100	53	51	7m.	Decided.	.20	0.6700	.0687	8.97	1.18	.0517	0.51	256,000
December, .	58,800	49	43	10m.	Decided.	.18	0.7400	.1210	7.93	1.93	.0660	0.79	79,500

Sewage applied, 400 gallons six times a week, January 1 to March 31; 200 gallons twelve times a week, April 1 to July 31; 300 gallons six times a week, August 1 to 21; 150 gallons twelve times a week, August 22 to October 21; 150 gallons three times a week, October 22 to 31; 150 gallons twelve times a week, November 1 to December 11; 300 gallons six times a week, December 12 to 18; 150 gallons twelve times a week, December 19 to 31. April 11 to 20, experiment interrupted by freshet. August 20 and 30, white worms found in under-drains, and under-drains flushed out. August 31 to December 17, a trap 18 inches high was attached to outlet. September 9, trap turned down and pipe flushed out. Surface raked 1 inch deep each week, except two omissions each in January and February. March 23, surface spaded 4 inches deep; October 22, 6 inches deep. During January, 14¾ inches of snow and 8¾ inches of ice removed from surface; during February, 8½ inches of snow and 8½ inches of ice removed; during March, 5½ inches of snow removed; during December, 9½ inches of snow and ¼ inch of ice removed.

Filter No. 6.

This filter contains 44 inches in depth of mixed coarse and fine sand of an effective size of 0.35 millimeter. In common with some of the other outdoor filters it was giving an effluent of a very poor quality at the beginning of the year, owing to the destruction of nitrification during the cold weather of October and November, 1894. Efforts were made to re-establish nitrification in the filter by keeping its surface in such a condition that it would dispose of the applied sewage freely, but nitrification did not become active until the warmer weather of March came to its aid. From the first part of April throughout the remainder of the year the nitrates of the effluent were very high and the quality of the effluent exceedingly satisfactory, especially considering the strength of the applied sewage and the shallowness of the filter. Sewage was applied to the filter at an average rate of 59,800 gallons per acre daily for the first three months of the year and the average rate of application from April 1 until the end of the year was 58,500 gallons per acre daily. The surface of the filter was spaded over 4 inches deep on March 23, raked to a depth of 3 inches August 20 and spaded over to a depth of 6 inches October 22. The following table shows the work of the filter for the year: —

Monthly Averages of Analyses of Effluent of Filter No. 6.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	57,800	47	37	10h. 35m.	Decided.	.58	2.3020	.1500	9.54	0.45	.1370	1.15	49,400
February, .	61,700	50	35	9h. -	Decided.	.68	3.0625	.1850	9.49	0.12	.0270	1.20	30,700
March, .	60,000	47	38	41m.	Decided.	.51	1.7750	.1425	7.08	1.37	.2438	1.09	45,500
April, .	60,000	48	43	17m.	Decided.	.30	0.7327	.0829	8.86	2.16	.2333	0.88	69,000
May, . .	60,000	57	56	5m.	Slight.	.19	0.0094	.0386	11.32	3.13	.0031	0.32	17,220
June, . .	62,400	68	68	12m.	V slight.	.18	0.0051	.0461	12.73	4.89	.0003	0.29	12,192
July, . .	58,100	68	70	3m.	None.	.12	0.0014	.0255	14.32	4.43	.0002	0.17	4,928
August, .	55,500	69	74	3m.	None.	.11	0.0026	.0311	15.33	3.65	.0007	0.21	6,167
September,	60,000	66	71	6m.	None.	.11	0.0327	.0340	14.00	3.77	.0053	0.21	3,638
October, .	44,400	55	56	1h. 28m.	None.	.09	0.0373	.0230	11.64	2.32	.0290	0.19	2,248
November,	53,000	55	51	1h. 43m.	V. slight	.12	0.2040	.0289	8.64	2.44	.0790	0.34	5,120
December,	57,700	49	42	10m.	V. slight.	.19	0.5600	.0500	8.58	1.70	.1975	0.41	4,491

Sewage applied, 300 gallons six times a week, January 1 to October 22; 150 gallons three times a week, October 23 to 31; 300 gallons 6 times a week, November 1 to December 31. April 11 to 20, experiment interrupted by freshet. August 31 to September 11, a trap 18 inches high was attached to outlet pipe. September 9, trap turned down and pipe flushed out. Surface raked 1 inch deep each week, except two omissions in January and two in February. March 23, surface spaded over 4 inches deep; August 20, 3 inches deep; October 22, 6 inches deep. During January, 11½ inches of snow and 8⅞ inches of ice removed from surface; during February, 17 inches of snow and 8¾ inches of ice removed; during March, 5 inches of snow removed; during December, 8 inches of snow and ¾ inch of ice removed.

Filter No. 9 A.

This filter contains 5 feet in depth of sand of an effective size of 0.17 millimeter. At the beginning of the year nitrification had almost ceased in the filter, owing to the prolonged resting during the latter part of 1894. The surface of the filter was in fairly good condition and the applied sewage passed below the surface as readily as is usual in cold winter weather. On February 1 the filter was covered with canvas stretched over a frame, but nitrification did not become re-established until warmer weather began in March. Throughout the remainder of the year the filter was in good condition, nitrification was active and the effluent of a satisfactory quality. As the cold weather of fall and early winter began, the process of nitrification became somewhat less active and the ammonias of the effluent greater, but the physical condition of the filter was excellent and it was taking the applied sewage readily. The character of the effluent tends to show that a filter of this depth, entirely under-drained and containing sand of this grade, cannot, with the quantities of sewage applied, cause an entire transformation of such large quantities of nitrogen as are now present in the sewage, in the form of free ammonia and organic nitrogen, into nitrogen in the form of nitrates, except during those periods of warm weather when nitrification is most active. The filter was spaded over 4 inches deep March 23, raked to a depth of 3 inches August 20, and spaded over to a depth of 6 inches September 7 and November 8. The following table shows the monthly averages of the weekly analyses: —

Monthly Averages of Analyses of Effluent of Filter No. 9 A.

[Parts per 100,000.]

1895.	Quantity Applied.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Gallons per Acre Daily for Six Days in a Week.	Sewage.	Effluent.	Hours and Minutes.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	80,000	50	36	7h. 50m.	Decided.	.62	3.8700	.1960	8.41	0.29	.0276	1.37	145,000
February, .	73,300	46	35	12h. 40m.	Decided.	.59	3.7125	.1700	8.93	0.19	.0217	1.14	107,100
March, .	80,000	44	38	1h. 20m.	Decided.	.52	2.0500	.1725	7.96	1.03	.0875	0.99	76,400
April, .	53,300	46	44	1h. 22m.	Slight.	.25	0.7868	.0871	8.41	2.40	.1500	0.63	29,000
May, . .	80,000	58	58	57m.	None.	.14	0.0068	.0255	10.10	3.08	.0001	0.22	1,237
June, . .	82,400	69	67	40m.	V. slight.	.10	0.0340	.0234	13.07	4.27	.0025	0.23	1,036
July, . .	77,000	69	72	49m.	None.	.12	0.0203	.0204	3.44	3.84	.0004	0.21	614
August, .	57,800	70	72	42m.	None.	.11	0.0392	.0221	16.39	3.42	.0025	0.22	2,486
September,	60,000	67	71	9m.	None.	.11	0.0209	.0219	15.37	4.30	.0010	0.23	519
October, .	44,400	55	61	39m.	V. slight.	.12	0.1051	.0208	9.97	2.78	.0020	0.23	2,299
November,	48,400	52	50	25m.	None.	.13	0.1694	.0324	7.92	3.19	.0113	0.23	3,850
December,	55,400	46	42	20m.	Slight.	.34	1.0200	.0885	8.08	1.56	.0588	0.60	7,661

Sewage applied, 400 gallons six times a week, January 1 to July 31; 300 gallons six times a week, August 1 to October 21; 150 gallons three times a week, October 22 to 31; 300 gallons six times a week, November 1 to December 31. April 11 to 20, experiment interrupted by freshet. Tank covered with canvas February 1 to March 13. Effluent pipe plugged August 30 and 31, and August 31 to September 4. A trap 18 inches high attached to outlet pipe August 31 to September 14. September 9, trap turned down and pipe flushed out. Surface raked 1 inch deep each week, except once in January and twice in February. March 23, surface spaded 4 inches deep; August 20, 3 inches deep; September 7, October 22 and November 8, 6 inches deep; November 20, 3 inches deep. During January, 15 inches of snow, and 3½ inches of ice removed from surface; during February, 1 inch of ice removed; during March, 2½ inches of snow removed; during December, 8 inches of snow and 2 inches of ice removed.

Filter No. 10.

This filter, one two-hundredth of an acre in area, contains 5 feet in depth of a mixed coarse and fine sand of an effective size of 0.35 millimeter. No gravel or under-drains are beneath the sand except directly above and around the outlet pipe. A partition extending 3 feet below the surface separates that quarter of the surface farthest removed from the under-drains from the remainder of the surface. To this quarter of the surface farthest from the under-drains the sewage is applied and, during January, the rate of application was 160,000 gallons per acre daily. The filter had not rested during November, 1894, and nitrification was fairly active but steadily decreased and the free ammonia of the effluent was high. The applied

sewage contained a large percentage of organic matter in suspension, and this, together with the extremely cold weather and the consequent depth of frost in the filter, clogged the surface of the filter to such a degree that the applied sewage was disposed of with difficulty, and on February 1 the rate of application was reduced to 80,000 gallons per acre daily and increased to 160,000 gallons per acre daily April 1. The character of the effluent deteriorated, however, during February, but improved rapidly in March and was fairly satisfactory during the remainder of the year. During the winter the sewage was applied to a trench 1 foot in depth and on March 23 this trench was filled and the surface of the filter levelled. Later in the spring it seemed probable that sub-surface clogging was taking place in the filter, and the quarter of the surface to which sewage is applied was dug over to the depth of 18 inches on May 18. This was followed by greatly improved nitrification. On October 22 the surface of the filter to which sewage is applied was spaded over to the depth of 6 inches. The following table gives the results of the monthly averages of the weekly analyses: —

Monthly Averages of Analyses of Effluent of Filter No. 10.

[Parts per 100,000.]

1895.	Quantity Applied — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg F.		Length of Time Sewage Remained on Surface. — Hours and Minutes	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	160,000	40	37	12h 34m.	Decided.	.40	1.9200	.0936	7.79	.86	.0128	.63	98,200
February, .	80,000	47	35	12h. -	Decided.	.71	2.6500	.1075	8.65	.31	.0112	.83	39,100
March, .	80,000	45	37	58m.	V. slight.	.44	1.3550	.0710	7.27	1.52	.0085	.51	22,950
April, . .	160,000	47	42	38m.	V. slight.	.14	.3100	.0400	8.79	2.22	.0175	.28	6,833
May, . .	160,000	58	56	7h. -	Slight.	.27	.1533	.0467	13.79	1.90	.0027	.41	5,935
June, . .	160,000	69	65	2m.	Slight.	.20	.3100	.0440	14.12	3.71	.0035	.36	6,384
July, . .	160,000	70	71	1m.	V. slight.	.12	.1073	.0193	15.06	3.42	.0013	.21	518
August, .	160,000	70	71	5m.	None.	.07	.0115	.0159	13.87	3.63	.0003	.16	177
September,	160,000	67	70	6m.	None.	.08	.0404	.0177	13.73	3.84	.0040	.17	205
October, .	160,000	55	61	7m.	None.	.07	.0222	.0146	10.02	3.12	.0041	.14	199
November, .	160,000	51	52	8h. 56m.	None.	.08	.1195	.0177	7.81	2.36	.0533	.20	1,570
December, .	160,000	45	44	8m.	V. slight.	.17	.8875	.0625	7.78	1.92	.2813	.36	4,885

Sewage applied, 200 gallons six times a week, January 1 to 31; 100 gallons six times a week, February 1 to March 31; 200 gallons six times a week, April 1 to July 31; 150 gallons six times a week, August 1 to October 22; 75 gallons three times a week, October 23 to 31; 150 gallons six times a week, November 1 to December 31. April 11 to 20, experiment interrupted by a freshet. August 31 to September 6, a trap 18 inches high was attached to outlet pipe. October 12, grass and weeds removed from that part of surface which is not flooded, and sand dug over 6 inches deep. That part of the surface to which sewage is applied has been raked once each week, except once in January and twice in February. May 18, that part of surface to which sewage is applied was spaded over 18 inches deep; August 20, 3 inches deep; October 22, 6 inches deep; December 27, 3 inches deep. During January, 16¾ inches of snow and 3 inches of ice removed from that part of surface to which sewage is applied; during February, 30½ inches of snow and 5¼ inches of ice removed; during March, 5¾ inches of snow removed; during April, ½ inch of snow removed; during December, 8 inches of snow and ¾ inch of ice removed.

Filters Nos. 12 A, 15 B and 16 B.

Filter No. 12 A contains 60 inches in depth of sand of an effective size of 0.19 millimeter, and filters Nos. 15 B and 16 B contain 65 inches in depth of gravel stones of an effective size of 5.40 millimeters. These three filters were first put in operation in July, 1892, and the effluents of filters Nos. 15 B and 16 B have uniformly been applied to Filter No. 12 A.

The actual rates of filtration in gallons per acre daily of these three filters during their period of operation up to Jan. 1, 1896, have been as follows: —

	1892.	1893.	1894.	1895.
Filter No. 15 B,	206,000	405,000	474,000	449,000
Filter No. 16 B,	206,000	432,000	463,000	465,000
Filter No. 12 A,	411,000	745,000	700,500	641,000
Average rate for the combined area,	137,000	248,300	233,500	214,000

Since the first part of 1893, filtration in filters Nos. 15 B and 16 B has been aided by a current of air drawn down through the filters. It is seen from the table above that Filter No. 12 A has not been able to take the entire volume of effluent of the gravel-stone filters during the past three years, and that its quantitative capacity has gradually decreased. Beginning March 24, 1893, the surface of Filter No. 12 A was scraped on an average once in five days during the year, to relieve clogging, and the average depth of sand removed at each scraping was 0.24 inch. The removed sand was washed and replaced. From Jan. 1, 1894, to June 19, 1894, the surface of this filter was scraped whenever necessary, to remove clogging, and the removed sand was not replaced.

The average interval between scrapings up to June 19 was seventeen days, and the average depth scraped was 0.17 of an inch, equivalent to 12 cubic yards of material removed per 1,000,000 gallons of partially purified sewage filtered. From this date until the end of 1894 the surface was raked to a depth of 3 inches twice each week and spaded over 6 inches deep September 6 and October 27, and 8 inches deep on November 21. The filter was in good condition at the beginning of 1895 and the same method of treatment

was continued, the surface being raked to a depth of 3 inches twice each week during the year and spaded over to a depth of 6 inches March 15, May 25, July 17 and August 3. Towards the end of September the filter began to be badly clogged, and was spaded over to a depth of 6 inches six times between September 21 and November 1, and to a depth of 8 inches seven times between November 1 and December 12. The quantitative capacity of the filter steadily decreased however, and on December 7 the surface sand to a depth of 7 inches was removed, washed and replaced. This sand, before washing, contained 76.10 parts of nitrogen by weight in 100,000 parts of dry sand, and after washing, 7.90 parts. Following this treatment the applied sewage was disposed of more readily. It seems probable that though the organic matters stored in the sand are not present in large quantities, they are of a fatty nature not easily acted upon bacterially; are, in fact, the organic matters that have been partially worked over while passing through the gravel filters and the more easily attacked portion removed. The effluent of Filter No. 12 A has been of most excellent quality throughout the year.

Filters Nos. 15 B and 16 B have received sewage during their period of operation at the rate in gallons per acre daily given in the preceding table. From the time the aspirators were attached to the filters until Sept. 1, 1894, a current of air was constantly drawn down through the filters at the rate of about one gallon in every four minutes. At this date the method of aëration was changed, so that the filters were aërated only at night for twelve or sixteen hours. Better results followed this method of aëration, and the volume of air supplied was sufficient, as shown by examination of the effluents for dissolved oxygen, it being almost uniformly present. The surfaces of these two filters were not disturbed until July, 1893, a year after they were first put in operation, but since that date they have been raked and spaded over very often. During 1895 they have been raked over once each week to a depth of 3 inches and spaded over 6 or 8 inches deep when the condition of the surface required it. There has been an accumulation of organic matter in the filters each year, and to such an extent that, in order to continue them in service, Filter No. 15 B had to be flushed out twice during 1894 by applying city water under pressure for six hours to the outlet pipe, the wash water flowing away over the top of the filter. Filter No. 16 B was given a similar flushing out during 1894, and later the

filtering material was entirely removed and replaced after washing. February 1, 1895, the entire filtering material of Filter No. 15 B was removed, washed and replaced, and after the high water of the Merrimack River in April, the upper 6 inches of gravel in both filters was removed and washed, to free it from river silt. The aspirator of Filter No. 16 B has been allowed to run from nine P.M. to five A.M. each night during the year, and that of 15 B for the same hours until September 2, since when it has been allowed to run from nine to eleven P.M. Aëration for two hours has sufficed to give a good effluent, but there has undoubtedly been a larger percentage of organic matter stored in the filter than there would have been with longer continued aeration each day. In conclusion it seems reasonable to say that the rate of application of sewage and the period of aëration should be so defined that flushing out the filters, or removing and washing the filtering material, would seldom be necessary, as these operations in themselves create a very large volume of sewage to be in some manner disposed of.

The quality of the effluents of these filters during 1895 is shown by the following tables: —

Monthly Averages of Analyses of Effluent of Filter No. 12 A.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	620,000	42	45	2h. 31m.	V. slight.	.19	.0014	.0282	7.75	2.57	.0000	.29	1,670
February, .	590,000	41	43	3h. –	V. slight.	.24	.1030	.0290	8.05	2.27	.0015	.37	2,866
March, .	701,000	44	48	2h. 45m.	V. slight.	.26	.0109	.0288	10.12	2.12	.0002	.37	2,145
April, .	402,000	47	50	2h. 19m.	None.	.27	.0019	.0277	11.07	2.31	.0000	.36	676
May, . .	804,000	58	56	2h. 31m.	V. slight.	.26	.0013	.0282	12.25	1.32	.0000	.33	606
June, . .	835,000	68	68	1h. 19m.	None.	.27	.0012	.0275	16.27	1.46	.0000	.33	474
July, . .	837,000	69	69	2h. 32m.	None.	.22	.0008	.0257	18.53	1.94	.0000	.30	377
August, .	855,000	71	71	2h. 22m.	None.	.19	.0012	.0206	14.43	2.60	.0000	.27	123
September,	874,000	67	65	2h. 35m.	None.	.17	.0013	.0237	16.71	3.44	.0000	.23	310
October, .	408,000	56	56	3h 22m.	None.	.34	.0046	.0249	12.12	2.35	.0003	.25	1,566
November,	254,000	54	54	3h. 30m.	None.	.17	.0098	.0340	8.76	2.40	0005	.18	971
December,	411,000	50	53	3h. –	None.	.19	.0010	.0222	8.69	1.81	.0002	.26	966

Effluent of filters Nos. 15 and 16 applied 24 times a week, January 1 to July 9; thirty times a week, July 10 to August 2; twenty-four times a week, August 3 to September 21; thirty times a week, September 22 to November 7; none applied October 18 to 26; once a week, November 8 to 24; twenty-four times a week, November 25 to December 31. April 11 to 24, experiment interrupted by freshet. Surface raked 3 inches deep twice each week. February 16, 6 inches of sand removed; sand replaced in tank March 1. February 18 and August 3, ½ inch of sand removed. Sand disturbed 6 inches deep on following dates: February 16, March 15, May 25, July 17, August 3, September 21, October 5, 10, 12, 18 and 28. Sand disturbed 8 inches deep on the following dates: November 8, 11, 15, 18, 22, 29 and December 2. December 7, 7 inches of sand removed, washed and replaced in tank.

Monthly Averages of Analyses of Effluent of Filter No. 15 B.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	310,000	47	43	25m.	Decided.	.56	1.1775	.1920	7.89	2.15	.0147	1.13	236,200
February, .	452,000	46	42	None.	Decided.	.85	2.0575	.3150	8.58	1.33	.0043	1.95	167,000
March, .	480,000	47	45	None.	Great.	.66	1.0100	.1715	10.86	2.21	.0170	1.41	142,000
April, .	303,000	51	48	None.	Great.	.55	0.3650	.1250	8.64	2.02	.0161	1.12	101,000
May, . .	480,000	62	57	None.	Decided.	.45	0.7136	.1300	15.33	1.10	.0272	0.90	192,000
June, . .	499,000	72	68	None.	Decided.	.43	0.4375	.1270	14.45	1.74	.0058	0.95	221,000
July, . .	462,000	71	68	None.	Decided	.58	1.4000	.2250	17.96	1.83	.0133	1.85	585,000
August, .	480,000	73	71	None.	Great.	.43	0.7067	.0805	14.60	2.14	.0093	0.76	266,000
September,	480,000	69	66	None.	Great.	.56	1.0000	.1825	15.28	2.50	.1025	1.14	482,000
October, .	480,000	56	55	None.	Decided.	.42	1.0000	.1573	11.16	2.35	.0967	0.94	364,000
November, .	480,000	54	55	None.	Great.	.52	0.8333	.1773	10.30	1.54	.4800	1.30	482,000
December, .	480,000	45	51	None.	Decided.	.63	0.9533	.1733	11.41	1.75	.0230	1.23	709,000

Sewage applied, 2 gallons seventy-two times a week. No sewage applied, January 4 to 10, January 28 to February 1. April 10 to 20, experiment interrupted by freshet. Filter was aspirated sixteen hours each night, January 1 to March 2, except from January 4 to 10, and January 28 to February 1, when aspirator was run continuously; eight hours a day, March 4 to May 13; fifteen minutes a day, May 14 to June 4; one hour a day, June 6 to 12; eight hours a day, June 13 to August 31; two hours a day, September 2 to December 31. February 1, all the gravel taken out of tank, washed and replaced. March 2, 5 inches of gravel removed from tank. April 20, 6 inches of gravel removed from tank, washed and replaced. Surface raked 3 inches deep once a week. Surface spaded 12 inches deep January 30. December 14, under-drains washed out with city pressure.

Monthly Averages of Analyses of Effluent of Filter No. 16 B.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	480,000	47	41	10m.	Decided.	.42	0.5480	.1552	8.43	1.84	.0116	1.01	410,000
February, .	480,000	46	39	None.	Decided.	.52	0.6200	.1730	8.33	1.91	.0092	1.19	263,800
March, .	480,000	47	43	None.	Great.	.40	0.2850	.1100	10.48	1.44	.0075	0.86	185,000
April, .	303,000	51	47	None.	Great.	.35	0.2200	.1110	9.87	1.49	.0090	0.85	156,000
May, . .	480,000	62	57	None.	Decided.	.28	0.3700	.1072	14.42	1.82	.0120	0.66	267,000
June, . .	499,000	72	67	None.	Great.	.65	1.0700	.1815	11.35	0.49	.0045	1.34	677,000
July, . .	462,000	71	69	30m.	Great.	.68	0.7680	.1348	17.36	1.47	.0092	0.84	451,000
August, .	480,000	73	71	None.	Decided.	.31	0.7800	.1340	14.48	1.98	.0098	0.93	341,000
September,	480,000	69	65	None.	Decided.	.43	1.3125	.2400	15.22	0.89	.0220	1.27	654,000
October, .	480,000	56	56	None.	Decided.	.31	0.9325	.1590	11.28	1.10	.0750	0.97	656,000
November,	480,000	54	52	None.	Decided.	.40	0.8767	.1847	9.80	0.99	.3267	1.15	657,000
December,	480,000	45	48	None.	Decided.	.49	1.1000	.1807	11.39	1.24	.0207	1.19	1,060,000

Sewage applied, 2 gallons seventy-two times a week. April 10 to 20, experiment interrupted by freshet. Filter aspirated eight hours each night. September 2 to 26, aspirator run at one-quarter regular speed. March 2, 5 inches of gravel removed from tank. April 20, 6 inches of gravel removed from tank, washed and replaced. December 14, under-drains washed out with city pressure. Surface raked 3 inches deep once a week.

Filter No. 13 A.

This filter contains 60 inches in depth of medium fine sand of an effective size of 0.19 millimeter, and has received the supernatant liquid from sewage which has been allowed to settle for four hours.

The rate of filtration during the greater part of 1895 has been approximately 160,000 gallons per acre daily. The filter was in good condition at the beginning of the year and was raked to a depth of 3 inches twice each week during the year and spaded over to a depth of 6 inches March 15, July 5, August 24, September 4 and 22, and October 4, 18 and 28. During the first eight months of the year nitrification was active in the filter although the effluent contained free ammonia in considerable quantity, but during September the nitrates of the effluent rapidly decreased and the filter was spaded over repeatedly to a depth of 6 inches, as noted above, but without appreciable effect upon the character of the effluent. On October 28 the gravel under-drains of the filter were flushed out with city water and a large amount of iron which had been deposited upon the gravel was in this way removed. Following this treatment the quality of the effluent rapidly improved, and during November and December the nitrates were the highest and the ammonias the lowest of the year. It seems probable that during September and October there was good nitrification within the filter but that the nitrates of the effluent were reduced to free ammonia while passing through the under-drains of the filter. The following table gives the monthly averages of the weekly analyses : —

Monthly Averages of Analyses of Effluent of Filter No. 13 A.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	160,000	47	44	48m.	V. slight.	.17	0.3140	.0252	9.10	2.23	.0029	.25	3,020
February, .	160,000	46	42	1h. 43m	Slight.	.37	0.5167	.0493	8.96	1.58	.0053	.38	13,730
March, .	147,700	47	47	2h. 10m.	Decided.	.69	1.5350	.0950	9.15	1.62	.0161	.93	46,739
April, . .	160,000	51	50	19m.	V. slight.	.12	0.0940	.0230	9.79	3.25	.0019	.20	1,904
May, . .	160,000	62	56	12m.	V. slight.	.10	0.1259	.0201	10.84	2.42	.0006	.18	427
June, . .	166,000	72	67	1h. 56m.	V. slight.	.29	0.3500	.0440	13.87	1.62	.0050	.30	1,146
July, . .	154,000	71	67	40m.	V. slight.	.47	0.7125	.0585	15.24	1.41	.0026	.53	908
August, .	154,000	73	71	3h. 37m.	V. slight.	.22	0.2453	.0313	15.25	2.05	.0090	.27	1,190
September,	153,600	69	66	4h. 25m.	Decided.	red	0.8367	.1293	13.55	0.59	.0123	.89	4,607
October, .	47,400	56	56	8h. -	Slight.	red	1.9900	.1055	12.72	0.10	.0160	.83	2,283
November, .	157,000	54	55	13m.	None.	.10	0.1260	.0313	8.04	3.06	.1712	.25	3,215
December, .	160,000	45	52	9m.	None.	.09	0.0043	.0161	8.48	3.59	.0021	.10	506

Settled sewage applied, 4 gallons twelve times a week. No sewage applied, October 17 to November 1. April 10 to 22, experiment interrupted by freshet. Surface raked 3 inches deep twice each week. Surface dug over 6 inches deep on the following dates: March 15, July 5, August 24, September 4, 22, October 4, 12, 18 and 28. October 28, under-drains washed out with city pressure.

Filter No. 14 A.

This filter contains 60 inches in depth of medium fine sand of an effective size of 0.19 millimeter, and has received since June 1, 1894, sewage which has been strained through a shallow layer of coke. This partially purified sewage has been applied to the filter at an average rate, excluding periods of rest, of 320,000 gallons per acre daily during the year. The surface of the filter has been raked to a depth of 3 inches twice each week during the year and spaded over to a depth of 6 inches, March 15, August 24 and October 6. The quality of the effluent has been satisfactory throughout the year and has invariably contained high nitrates. The filter was in excellent condition at the end of the year. The following table gives the monthly summary of the analyses made during the year: —

Monthly Averages of Analyses of Effluent of Filter No. 14 A.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	320,000	47	43	33m.	V. slight.	.14	0.2187	.0285	7.76	2.49	.0029	.23	5,190
February, .	317,000	46	42	1h. 42m.	Slight.	.43	1.7300	.0660	8.40	1.42	.0011	.61	2,770
March, .	295,000	47	45	1h. 26m.	Slight.	.34	1.0870	.0415	8.82	1.72	.0133	.43	11,909
April, .	320,000	51	48	58m.	Slight.	.50	1.5750	.0720	10.06	1.26	.0036	.51	9,800
May, . .	320,000	62	56	13m.	None.	.13	0.0435	.0270	13.13	2.66	.0048	.20	1,424
June, . .	333,000	72	68	19m.	None.	.13	0.0527	.0248	19.96	2.85	.0022	.23	317
July, . .	308,000	71	67	16m.	None.	.10	0.0119	.0223	17.75	3.12	.0004	.21	296
August, .	311,000	73	70	38m.	None.	.21	0.2438	.0305	16.86	3.00	.0014	.32	253
September,	320,000	69	65	19m.	None.	.13	0.0066	.0229	14.32	3.74	.0003	.22	122
October, .	207,000	56	55	14m.	None.	.14	0.0190	.0145	13.90	2.82	.0025	.21	233
November,	314,000	54	52	15m.	None.	.15	0.1208	.0358	8.49	2.67	.0013	.22	345
December,	320,000	45	·50	19m.	V. slight.	.19	0.0025	.0274	8.21	3.52	.0005	.25	1,657

Four gallons of sewage, strained through coke, applied twenty-four times a week. No sewage applied October 21 to November 1. April 10 to 20, experiment interrupted by freshet. Surface raked 3 inches deep twice each week. Surface dug over 6 inches deep on the following dates: March 15, August 24, October 4, 21 and 28.

Filter No. 19.

This filter contains 60 inches in depth of medium fine sand of an effective size of 0.19 millimeter, and has received the supernatant liquid from sewage which has been allowed to settle four hours after treatment with sulphate of alumina at the rate of 1,000 pounds per 1,000,000 gallons. The filter has received this supernatant liquid since Jan. 20, 1893, and the rate of application during 1895 has been, excluding periods of rest, 200,000 gallons per acre daily. Nitrification has been very active in the filter during the entire year, as shown by the high nitrates of the effluent. The albuminoid ammonia of the effluent was comparatively low during the year, and the comparatively high free ammonia was not caused by any clogging of the filter but was the natural consequence of the extremely high free ammonia of the applied sewage. The filter was raked 3 inches deep each week and spaded over 6 inches deep October 28.

Monthly Averages of Analyses of Effluent of Filter No. 19 A.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg F.		Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	200,000	47	40	38m.	V. slight.	.13	.4940	.0288	7.24	2.19	.1160	.36	3,770
February,	200,000	46	38	6h. 27m.	Slight.	.16	.7500	.0507	9.14	1.76	.0967	.43	3,570
March,	200,000	47	42	1h. 11m.	V. slight.	.15	.4325	.0265	7.66	2.09	.0850	.39	1,622
April,	200,000	51	47	35m.	V. slight.	.15	.4750	.0380	11.99	2.90	.0425	.36	1,820
May,	200,000	62	60	22m.	None.	.14	.5000	.0295	11.04	2.93	.0413	.30	422
June,	208,000	72	67	16m.	V. slight.	.17	.9150	.0525	16.55	4.42	.0083	.34	117
July,	193,000	71	67	13m.	None.	.16	.5175	.0415	15.08	3.94	.0004	.35	654
August,	196,000	73	70	14m.	V. slight.	.14	.1847	.0260	15.26	3.52	.0001	.29	469
September,	200,000	69	63	15m.	None.	.13	.1474	.0254	13.92	3.58	.0001	.23	125
October,	170,000	56	57	13m.	None.	.14	.3550	.0260	12.29	3.74	.0000	.26	69
November,	196,000	54	50	16m.	None.	.12	.1720	.0313	8.30	3.39	.0167	.27	92
December,	200,000	45	47	19m.	None.	.11	.4767	.0353	8.82	3.21	.0017	.24	319

Chemically precipitated sewage applied, 5 gallons twelve times each week. No sewage applied October 23 to November 1. April 10 to 20, experiment interrupted by freshet. Surface raked 3 inches deep twice each week. October 28, surface dug over 6 inches deep.

Filter No. 21 A.

This filter was started March 19, 1894. A portion of the filtering material was removed during 1894, but on April 1, 1895, the filter was restored to its original depth of 60 inches of fine sifted gravel of an effective size of 1.60 millimeters. Since July 7, 1894, it has had a current of air drawn downward through it, at the rate of about one gallon in four minutes, for ten or twelve hours each night. During 1895 this filter has received sewage during its period of actual operation at the rate of 360,000 gallons per acre daily, except during June and July, when the rate of application was 499,000 and 427,000 gallons per acre daily, respectively. The filter became badly clogged during February and was allowed to rest from February 18 to April 1, with continual aëration. This treatment improved the condition of the filter and restored nitrification. In August clogging again occurred and the filter was allowed to rest, with continuous aëration from August 7 to 21 inclusive. During the remainder of the year the filter was in good condition. The following table gives the results of the monthly averages of the weekly analyses: —

Monthly Averages of Analyses of Effluent of Filter No 21 A.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Average Number of Applications which Remained on Surface less than 30 Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	310,000	47	42	2	Decided.	0.46	1.1760	.1600	8.19	2.89	.0814	0.85	262,000
February, .	243,000	46	38	10	Decided.	1.30	2.7750	.3250	8.59	0.06	.0005	1.89	259,000
March, .	–	–	–	–	–	–	–	–	–	–	–	–	–
April, . .	332,000	51	48	10	Great.	0.45	0.6000	.2250	8.91	2.41	.0260	1.08	226,000
May, . .	267,000	62	54	4	Decided.	0.45	1.9500	.1860	11.87	1.57	.0110	1.50	188,000
June, . .	499,000	72	69	11	Slight.	0.30	0.0186	.0514	13.87	3.13	.0018	0.38	59,000
July, . .	427,000	71	70	4	Slight.	0.20	0.0305	.0327	15.36	4.04	.0015	0.29	87,000
August, .	219,000	73	75	9	Decided.	–	1.2150	.1350	16.29	0.19	.0215	1.02	399,000
September,	360,000	69	67	12	Slight.	0.23	0.2500	.0524	16.17	3.52	.0057	0.35	111,000
October, .	360,000	56	55	12	Slight.	0.31	0.6700	.1067	11.07	3.07	.0304	0.70	203,000
November,	360,000	54	51	12	Decided.	0.34	0.6433	.1020	10.05	3.02	.1253	0.89	282,000
December, .	360,000	45	47	12	Decided.	0.33	0.3967	.1140	10.03	3.38	.0100	0.76	307,000

Sewage applied, 2 gallons twelve times a day at intervals of one-half hour, six days in a week, January 1 to August 20; 1½ gallons twelve times a day from August 21 to December 31. No sewage applied and aspiration continuous, January 5 to 10, January 28 to February 3, February 18 to March 31, May 18 to 31, August 7 to 20. April 10 to 21, experiment interrupted by freshet. Filter aspirated sixteen hours each night. Surface raked 3 inches deep daily January 1 to March 31, and once a week during the remainder of the year. April 1, filter filled to its original depth with washed gravel. April 20, 6 inches of gravel removed, washed and replaced in tank. January 30, surface dug over 12 inches deep. Surface scraped on January 4 and April 1.

Filter No. 22 A.

This filter contained originally 60 inches of fine coke breeze above the usual under-drains. The rate of filtration during 1895 has been 360,000 gallons per acre daily. On account of clogging during February the filter was allowed to rest from February 18 to April 1. The surface of the filter was raked to a depth of 3 inches daily until the period of rest and to the same depth twice each week during the remainder of the year. Up to Nov. 14, 1894, 3.5 inches of the surface coke had been removed, equivalent to 8.6 cubic yards per 1,000,000 gallons of sewage filtered. During 1895 6.1 inches of coke were removed up to November 14, equivalent to 15 cubic yards per 1,000,000 gallons of sewage filtered. With the exception of the months of January and February nitrification in the filter was active throughout the year. The table of monthly averages of the weekly analyses is presented below: —

Monthly Averages of Analyses of Effluent of Filter No. 22 A.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	360,000	47	40	29m.	Decided.	.32	2.2140	.1268	8.31	0.57	.0067	.72	254,000
February, .	215,000	46	37	22m.	Decided.	.57	3.0250	.1350	7.74	0.18	.0057	.57	153,000
March, .	-	-	-	-	-	-	-	-	-	-	-	-	-
April, .	245,000	51	48	7m.	Decided.	.33	1.3250	.1650	9.86	1.97	.0590	.68	132,000
May, . .	360,000	62	57	25m.	Slight.	.30	1.2080	.0760	12.68	1.16	.0124	.44	94,000
June, . .	374,000	72	69	12m.	Decided.	.35	0.7900	.0730	14.72	1.55	.0110	.50	338,000
July, . .	347,000	71	68	29m.	Decided.	.31	0.3700	.0590	18.09	2.10	.0084	.47	78,000
August, .	360,000	73	71	14m.	Decided.	.26	0.1582	.0412	13.93	2.30	.0060	.32	92,000
September,	360,000	69	66	23m.	Decided.	.23	0.1233	.0527	14.44	2.34	.0150	.33	86,000
October, .	360,000	56	53	13m.	Slight.	.33	0.7633	.0637	11.28	1.63	.0087	.41	102,000
November,	360,000	54	47	50m.	Decided.	.35	0.9575	.0730	8.51	1.35	.0450	.52	128,000
December,	360,000	45	46	23m.	Decided.	.54	1.4300	.1640	9.93	0.94	.0267	.60	479,000

Sewage applied, 6 gallons eighteen times a week. No sewage applied February 18 to March 31. April 10 to 21, experiment interrupted by freshet. Surface raked 3 inches deep daily, January 1 to 31, and once a week during the remainder of the year. February 1, 3 inches of coke removed, and 3 inches of clean coke put on filter. February 18, ½ inch of coke removed from filter; November 15, 3.1 inches removed.

Filters Nos. 51 and 52.

Each of these filters is one three-thousandth of an acre in area. Filter No. 51 contains 60 inches in depth of gravel of an effective size of 5.30 millimeters above the usual under-drains, and Filter No. 52 contains 60 inches in depth of coke breeze, from which the finer particles have been removed, above the usual under-drains. The outlets of these two filters have been trapped and they have been aërated by means of a fan blower driven by electric power, as previously described. Beginning February 1, each of these filters received sewage at the rate of 500,000 gallons per acre daily, applied in six doses between 6 A.M. and noon. This rate of filtration and method of application continued until May 2, when the method of application was changed so that twice this volume of sewage was applied in twelve doses between 7 A.M. and 11 P.M., giving a rate of 1,000,000 gallons per acre daily. This continued until June 21. From June 21 to June 25 inclusive the filters were allowed to rest, and on June 26 they were started again, but the rate of application of sewage was reduced to 500,000 gallons per acre daily, applied in six doses between 7 A.M. and 10 P.M. This continued until June 29, when the same quantity of sewage was applied in twelve doses between 7 A.M. and 11.30 P.M. During these first five months of operation of the filters nitrification did not become well established, and although there was a considerable reduction of the free and albuminoid ammonia of the sewage in passing through the filters, it was largely on account of retention and storage in the filters. From July 2 to 7 inclusive, the rate of application was 250,000 gallons per acre daily, and from July 8 to 17 inclusive, the filters were operating very poorly, the method of application was irregular and the average rate was less than 100,000 gallons per acre daily. This low rate improved the condition of the filters and nitrification became established.

From July 18 to August 13 the rate of filtration was 250,000 gallons per acre daily and was applied in three doses between 7 A.M. and 2.30 P.M. From August 14 to September 2 inclusive, the rate of filtration was 500,000 gallons per acre daily, applied in six equal doses between 7 A.M. and 10 P.M., and from September 2 until the end of the experiment, December 10, the rate was 1,000,000 gallons per acre daily, applied in twelve equal doses between 7 A.M. and 11.30 P.M. During the last five months of operation of the filters

nitrification was active within the filters, but the effluents, especially that of Filter No. 51, contained a large amount of free and albuminoid ammonia. The better clarification of the effluent of Filter No. 52 was on account of greater storage of organic matter within the filter.

From February 12 to May 2 the filters were aërated two hours daily, from 2 to 4 P.M. From May 2 to June 1, one and one-half hours daily, divided into half-hour periods, June 1 to 15, six half hours daily, June 16 to July 10, twelve half hours daily, July 15 to August 5, fourteen hours daily. August 6 to 11 the motor was out of order and the average period of aëration was one and one-half hours daily, with no aëration on August 7, 9 and 10. From August 13 to September 3 the filters were aërated fourteen hours daily, and from September 3 until the end of the experiment, with a few exceptions, the filters were aërated two and three-fourths hours daily, in fifteen minute periods, half way between the times of applying the sewage.

Monthly Averages of Analyses of Effluent of Filter No. 51.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	500,000	46	47	Decided.	1.30	2.5167	.3767	13.13	0.00	.0000	2.30	781,500
March, . .	500,000	47	51	Great.	1.23	2.2400	.3360	7.51	0.22	.0340	2.32	226,000
April, . .	500,000	51	52	Decided.	0.93	1.8333	.3367	8.69	0.64	.1547	2.30	581,000
May, . .	1,000,000	60	60	Great.	0.57	1.8900	.2960	11.89	0.45	.0162	1.47	630,000
June, . .	675,000	72	72	Great.	-	2.8625	.3275	11.03	0.02	.0000	1.95	423,000
July, . .	165,000	71	71	Great.	red	3.8833	.3867	18.26	0.80	.0437	2.15	725,000
August, . .	500,000	73	72	Great.	-	1.9700	.4364	17.29	2.19	.1670	2.75	685,000
September, .	1,000,000	69	69	Great.	-	1.6500	.5075	12.62	1.48	.1613	2.83	874,000
October, .	1,000,000	56	56	Great.	-	1.7900	.3936	9.89	1.52	.3260	2.98	785,000
November, .	1,000,000	54	54	Great.	0.70	1.1300	.3100	8.75	1.33	.4500	3.25	489,000
December, .	1,000,000	45	52	Great.	0.80	0.7250	.4600	5.44	1.85	.1750	2.80	529,000

Sewage applied, 25 gallons thirty-six times a week, February 1 to April 30; 25 gallons seventy-two times a week, May 1 to June 25; 25 gallons thirty-six times a week, June 26 to 28; 12½ gallons seventy-two times a week, June 29 to July 1; 12½ gallons thirty-six times a week, July 2 to 7; 6¼ gallons thirty-six times a week, July 8 to 17; 25 gallons eighteen times a week, July 18 to August 13; 25 gallons thirty-six times a week, August 14 to September 1; 25 gallons seventy-two times a week, September 2 to December 10. Blower ran 2 hours six times a week, February 18 to April 30; ½ hour eighteen times a week, May 1 to June 3; ½ hour thirty-six times a week, June 4 to 14; ½ hour seventy-two times a week, June 15 to July 9; 13½ hours daily, six days a week, July 10 to September 1; 15 minutes sixty-six times a week, September 2 to December 10. February 4, a trap 2 feet high was attached to outlet. March 2, 5 inches of gravel removed from filters 15 and 16, and the whole quantity thoroughly mixed with the top foot of gravel in Filter No. 51. April 15 to 21, experiment interrupted by freshet. Trap washed out once a week after July 22. Surface raked 3 inches deep once a week, April 1 to September 2. Surface dug over 6 inches deep July 10 and November 30.

Monthly Averages of Analyses of Effluent of Filter No. 52.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	500,000	46	46	Decided.	1.27	3.1667	.2933	11.95	0.00	.0001	1.93	1,163,000
March, . .	500,000	47	50	Great.	1.27	2.7300	.3160	7.25	0.15	.0470	2.18	238,000
April, . .	500,000	51	52	Great.	0.70	2.1333	.3033	8.66	0.43	.0997	2.00	433,000
May, . .	1,000,000	62	60	Great.	0.66	1.4500	.2040	11.69	0.47	.0159	1.19	648,000
June, . .	675,000	72	72	Great.	0.90	2.1375	.2825	11.64	0.07	.0000	1.52	405,000
July, . .	165,000	71	71	Great.	red	2.3333	.1833	17.32	0.02	.0000	1.25	118,000
August, . .	500,000	73	72	Great.	-*	1.2700	.1776	17.21	1.61	.0846	1.20	433,000
September, .	1,000,000	69	69	None.	red	1.7250	.2550	15.83	0.69	.0647	1.80	195,000
October, .	1,000,000	56	56	None.	0.57	2.4700	.3060	11.52	0.43	.1741	1.94	408,000
November, .	1,000,000	54	54	None.	0.75	1.4000	.2850	8.45	1.05	.0250	1.60	398,000
December, .	1,000,000	45	51	Great.	0.58	1.2250	.2450	6.56	0.48	.1400	1.25	343,000

* Brown.

Sewage applied, 25 gallons thirty-six times a week, February 1 to April 30; 25 gallons seventy-two times a week, May 1 to June 25; 25 gallons thirty-six times a week, June 26 to 28; 12½ gallons seventy-two times a week, June 29 to July 1; 12½ gallons thirty-six times a week, July 2 to 7; 6¼ gallons thirty-six times a week, July 8 to 17; 25 gallons eighteen times a week, July 18 to August 13; 25 gallons thirty-six times a week, August 14 to September 1; 25 gallons seventy-two times a week, September 2 to December 10. Blower ran 2 hours six times a week, February 18 to April 30; ½ hour eighteen times a week, May 1 to June 3; ½ hour thirty-six times a week, June 4 to 14; ½ hour seventy-two times a week, June 15 to July 9; 13½ hours daily six days a week, July 10 to September 1; 15 minutes sixty-six times a week, September 2 to December 10. February 4, a trap 2 feet high was attached to outlet. April 15 to 21, experiment interrupted by freshet. Trap washed out once a week after July 22. August 1 to 4, all the air from the blower passing through tank. Surface raked 3 inches deep once a week, April 1 to September 2. Surface dug over 6 inches deep July 10, November 30, and 12 inches deep July 26.

Filter No. 53.

This filter is one twenty-thousandth of an acre in area, and contains 60 inches in depth of sand of an effective size of 0.19 millimeter. From February 1 to May 17 it received the effluent of No. 51 at the rate of 1,000,000 gallons per acre daily. Following this treatment the surface of the filter became so badly clogged by the excessive application of partially purified sewage that the rate had to be greatly reduced and was quite irregular in volume, the average rate from May 17 to July 19 averaging considerably less than 500,000 gallons per acre daily. From this last date until the end of the experiment, December 10, the average rate was 500,000 gallons per

acre daily. During this last period the applied effluent of Filter No. 51 was fairly well purified and contained nitrates in considerable quantity. The filter was allowed to rest from June 21 to 25 inclusive and July 11 to 15 inclusive. The surface was raked 3 inches deep twice each week during April, and beginning May 2, to the same depth daily. The surface was spaded over to a depth of 6 inches May 22, June 3, 13, 20 and November 22. The following table shows the results of the monthly averages of the analyses of the effluent of this filter: —

Monthly Averages of Analyses of Effluent of Filter No. 53.

[Parts per 100,000.]

1895.	Quantity Applied — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	1,003,000	46	50	Slight.	.36	3.0833	.1767	12.77	0.06	.0007	.77	1,041,000
March, . .	1,006,000	47	54	Slight.	.41	1.7414	.1352	7.65	1.68	.0854	.74	62,000
April, . .	789,000	51	49	V. slight.	.31	0.0127	.0467	8.83	1.93	.0037	.48	46,000
May, . .	973,000	62	58	V. slight.	.28	0.2476	.0576	11.16	1.09	.0020	.55	416,000
June, . .	867,000	72	69	Decided.	.56	0.6225	.1080	12.00	0.45	.0345	.88	95,000
July, . .	353,000	72	69	V. slight.	.30	0.3482	.0766	16.17	2.73	.0066	.27	28,000
August, .	500,000	75	70	V. slight.	.21	0.0391	.0356	17.36	2.71	.0008	.30	6,000
September, .	500,000	69	67	V. slight.	.20	0.0181	.0304	19.36	2.23	.0023	.33	4,000
October, .	500,000	55	51	None.	.16	0.0578	.0252	13.72	3.98	.0018	.27	10,000
November, .	498,000	57	54	V. slight.	.27	0.0059	.0390	9.09	3.15	.0007	.34	14,000
December, .	500,000	53	58	V. slight.	.19	0.0132	.0291	8.81	3.03	.0002	.25	8,000

Effluent of Filter No. 51 applied, $16\frac{2}{3}$ gallons eighteen times a week, February 1 to May 1; $12\frac{1}{2}$ gallons twenty-four times a week, May 2 to July 1; from July 2 to 22, amount of applied effluent varied from 2 gallons to $32\frac{1}{2}$ gallons daily; $12\frac{1}{2}$ gallons twelve times a week, July 23 to December 10. February 18, $\frac{1}{2}$ inch of sand removed from surface of Filter No. 12 and thoroughly mixed with top foot of sand in Filter No. 53. April 15 to 21, experiment interrupted by freshet. Surface raked 3 inches deep once a week, April 1 to 22, and daily from April 23 to December 10. Surface dug over 6 inches deep, May 22, June 3, 13, 20, November 22.

Filter No. 54.

This filter is a duplicate of Filter No. 53, and has received during its period of operation the effluent of Filter No. 52. The effluent was applied at an average rate of 1,000,000 gallons per acre daily until the middle of June, when the surface of the filter became badly clogged. On June 13 the surface was spaded over to a depth of 6 inches and the filter was allowed to rest from June 21 to 25 in-

clusive. The condition of the filter did not improve and the average rate of application of the partially purified sewage was, during July, 356,000 gallons per acre daily. During the remaining period of operation of this filter the applied effluent contained nitrogen, in the form of nitrates, in considerable quantities, and was of such quality that the filter disposed of it at an average rate of 500,000 gallons per acre daily, without difficulty. The surface of the filter was raked to a depth of 3 inches once each week from April 1 until April 23, and after this date to the same depth daily. The surface was spaded over to a depth of 6 inches May 25, June 13, 29 and November 6. The quality of the effluent during the period of operation of the filter is shown by the following table: —

Monthly Averages of Analyses of Effluent of Filter No. 54.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February,	976,000	47	46	Slight.	.35	3.2500	.1533	11.53	0.01	.0015	.64	1,297,000
March,	1,011,000	50	51	Slight.	.38	2.8600	.1220	7.64	0.51	.0170	.65	35,000
April,	788,000	51	49	V. slight.	.28	0.3687	.0480	8.66	1.74	.0083	.44	10,000
May,	977,000	62	58	V. slight.	.23	0.0338	.0360	11.33	1.54	.0044	.39	10,000
June,	792,000	71	68	V. slight.	.29	0.0582	.0430	12.45	1.55	.0050	.41	9,000
July,	356,000	72	69	V. slight.	.21	0.0081	.0402	17.43	3.06	.0007	.31	5,000
August,	500,000	75	69	V. slight.	.15	0.0044	.0259	16.49	2.44	.0003	.23	14,000
September,	500,000	69	67	V. slight.	.18	0.0145	.0278	17.38	2.19	.0001	.26	13,000
October,	500,000	55	52	None.	.17	0.0174	.0259	13.00	2.58	.0001	.26	3,000
November,	475,000	57	48	None.	.38	0.8164	.0503	9.65	1.31	.0072	.48	2,600
December,	468,000	53	55	None.	.16	0.0102	.0248	8.54	1.94	.0011	.24	500

Effluent of Filter No. 52 applied, $16\frac{2}{3}$ gallons eighteen times a week, February 1 to May 1; $12\frac{1}{2}$ gallons twenty-four times a week, May 2 to June 29; from June 30 to July 21, amount of applied effluent varied from 3 gallons to $47\frac{1}{2}$ gallons daily; $12\frac{1}{2}$ gallons twelve times a week, July 22 to December 10. April 15 to 21, experiment interrupted by freshet. Surface raked 3 inches deep once a week, April 1 to 22, and daily from April 23 to December 10. Surface dug over 6 inches deep, May 25, June 13, 29, November 24, December 5.

Filter No. 55.

This filter is one twenty-thousandth of an acre in area, and contains, over the usual gravel under-drains, 5 feet in depth of sand of an effective size of 0.40 millimeter. To this filter the effluent of

Filter No. 51 was applied. The average rate of application during the first five months of operation of the filter was, excluding periods of rest, 1,000,000 gallons per acre daily. The surface of the filter became very badly clogged by this excessive application of partially purified sewage and the filter was allowed to rest from July 3 to 15 inclusive. During the remainder of the year the rate of application was 500,000 gallons per acre daily. The surface of the filter was not disturbed until April; during April it was raked 3 inches deep each week until April 23, and from this last date, until the end of the experiment, to the same depth daily. The surface of the filter was dug over to a depth of 6 inches April 13, May 24, June 7 and 18. The quality of the effluent of the filter is shown by the following table: —

Monthly Averages of Analyses of Effluent of Filter No. 55.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	1,003,000	47	48	Decided.	.48	2.7667	.2233	13.09	0.007	.0005	1.01	3,524,000
March, . .	1,006,000	50	53	Decided.	.55	2.4700	.1340	7.94	0.700	.0370	0.95	68,000
April, . .	750,000	51	50	Slight.	.44	0.4460	.0753	8.71	2.070	.0500	0.67	84,000
May, . .	974,000	62	59	Slight.	.37	0.2988	.0746	10.98	1.300	.0136	0.66	110,000
June, . .	851,000	71	70	Great.	.76	1.1525	.1405	11.96	0.320	.0320	1.20	126,000
July, . .	230,000	72	69	Decided.	.60	1.2707	.1220	16.85	1.180	.0347	0.81	337,000
August, .	500,000	75	71	Decided.	.34	0.0668	.0632	17.35	3.020	.0112	0.44	269,000
September, .	500,000	69	68	Decided.	.31	0.0367	.0500	18.81	2.930	.0020	0.46	168,000
October, .	500,000	55	53	Decided.	.30	0.0633	.0520	15.39	4.210	.0206	0.42	71,000
November, .	500,000	57	51	Slight.	.37	0.0570	.0570	9.03	3.510	.0130	0.47	73,000
December, .	500,000	53	55	Slight.	.35	0.0440	.0580	8.41	3.230	.0070	0.43	48,000

Effluent of Filter No. 51 applied, 16⅔ gallons eighteen times a week, February 1 to May 1; 12½ gallons twenty-four times a week, May 2 to July 1; none applied July 2 to 15; from July 16 to 22, amount of applied effluent varied from 3 gallons to 25 gallons daily; 12½ gallons twelve times a week, July 23 to December 10. February 18, ½ inch of sand removed from surface of Filter No. 1 and thoroughly mixed with top foot of sand in Filter No. 55. April 15 to 21, experiment interrupted by freshet. May 24, a ¾-inch pipe, similar to the ones in filters 15 and 16, was driven down through the center of the filter, and an aspirator attached. Surface raked 3 inches deep once a week, April 1 to 22, and daily from April 23 to December 10. Surface dug over 6 inches deep April 13, May 24, June 7, 18.

Filter No. 56.

This filter is in area and construction a duplicate of Filter No. 55, and has had applied to it, during its period of operation, the effluent of Filter No. 52. The rate of application of this effluent was, during the first five months of operation of the filter, approximately 1,000,000 gallons per acre daily. The surface of the filter became quite badly clogged during July and the rate of application was very much reduced, averaging for the month 356,000 gallons per acre daily. From the beginning of August until the end of the experiment the quality of the effluent of Filter No. 52 was much improved, and was disposed of readily by Filter No. 56 at an average rate of 500,000 gallons per acre daily. The surface of the filter was not disturbed until April. During the first three weeks of April it was raked to a depth of 3 inches three times, and beginning April 23, to the same depth daily.

Monthly Averages of Analyses of Effluent of Filter No. 56.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre. Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	974,000	47	47	Decided.	.36	3.2833	.1666	11.87	0.00	.0005	.73	3,621,000
March, . .	1,011,000	50	52	Slight.	.43	2.4700	.1160	7.72	0.60	.0238	.77	48,000
April, . .	788,000	51	50	V. slight.	.38	0.1953	.0533	8.58	2.83	.0183	.47	21,000
May, . .	963,000	62	58	Slight.	.28	0.0613	.0641	11.15	2.46	.0172	.46	101,000
June, . .	878,000	71	69	Slight.	.33	0.1003	.0695	12.16	1.91	.0480	.48	55,000
July, . .	356,000	72	69	Slight.	.29	0.2400	.0553	16.82	2.15	.0273	.40	395,000
August, . .	500,000	75	70	V. slight.	.17	0.0076	.0360	16.41	2.73	.0083	.24	24,000
September, .	500,000	69	68	V. slight.	.20	0.0344	.0338	17.55	2.06	.0018	.30	41,000
October, .	500,000	55	53	None.	.18	0.0281	.0266	13.19	2.33	.0040	.27	11,000
November, .	477,000	57	53	Slight.	.53	2.1800	.0950	9.18	0.84	.0560	.73	30,000
December, .	500,000	53	54	Slight.	.21	0.0082	.0288	8.63	2.00	.0065	.27	20,000

Effluent of Filter No. 52 applied, 16⅔ gallons eighteen times a week, February 1 to May 1; 12½ gallons twenty-four times a week, May 2 to June 28; from June 29 to July 21, the amount of applied effluent varied from 3 gallons to 47½ gallons daily; 12½ gallons twelve times a week, July 22 to December 10. April 15 to 21, experiment interrupted by freshet. Surface raked 3 inches deep once each week, April 1 to 22, and daily from April 23 to December 10. Surface dug over 6 inches deep, November 23.

Filter No. 57.

This filter is one twenty-thousandth of an acre in area, and contains, over the usual under-drains, 5 feet in depth of coke breeze. The effluent of Filter No. 51 has been applied to this filter. During the first five months of its period of operation the rate of application was, approximately, 1,000,000 gallons per acre daily. This rate of application overtaxed the capacity of the filter and its surface became so badly clogged that during July the rate of application was very much reduced and was quite irregular. From the first of August through the remaining months of operation of the filter it disposed of the better purified effluent of Filter No. 51 without difficulty at an average rate of 500,000 gallons per acre daily. The surface of the filter was not disturbed until April. During April the surface was raked to a depth of 3 inches three times up to April 23 and from that date daily throughout the remaining months of the experiment.

Monthly Averages of Analyses of Effluent of Filter No. 57.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
February, .	1,003,000	47	48	Decided.	.35	2.8833	.1467	11.67	0.00	.0007	.73	490,000
March, . .	1,006,000	50	53	Slight.	.57	2.2700	.1840	8.03	0.56	.0267	.87	68,000
April, . .	788,000	51	51	Slight.	.55	0.4433	.0767	8.44	1.74	.0133	.64	79,000
May, . .	1,014,000	62	59	Decided.	.32	0.2120	.0636	10.82	1.49	.0132	.51	128,000
June, . .	875,000	71	70	Slight.	.31	0.6550	.0650	12.05	1.16	.0205	.41	44,000
July, . .	353,000	72	69	Slight.	.42	1.3567	.0660	16.27	0.85	.0133	.44	154,000
August, .	500,000	75	71	Slight.	.28	0.1860	.0400	17.01	2.34	.0186	.33	214,000
September, .	500,000	69	68	Decided.	.29	0.1053	.0487	17.89	2.38	.0067	.36	107,000
October, .	500,000	55	54	Slight.	.22	0.0627	.0373	14.17	3.16	.0093	.32	68,000
November, .	500,000	57	53	Slight.	.33	0.1920	.0400	9.48	2.77	.0240	.38	22,000
December, .	500,000	53	55	Slight.	.31	0.3730	.0460	9.01	2.63	.0200	.37	18,000

Effluent of Filter No. 51 applied, 16⅔ gallons eighteen times a week, February 1 to May 1; 12½ gallons twenty-four times a week, May 2 to June 28; from June 29 to July 22, the amount of applied effluent varied from 2 gallons to 47½ gallons daily; 12½ gallons twelve times a week, July 23 to December 10. April 15 to 21, experiment interrupted by freshet. Surface raked 3 inches deep once each week, April 1 to 22, and daily from April 23 to December 10.

Filter No. 58.

This filter is, in area and construction, a duplicate of Filter No. 57, and has had applied to it during its period of operation the effluent of Filter No. 52. During the first five months of its period of operation the rate of application was, approximately, 1,000,000 gallons per acre daily. This overtaxed the capacity of the filter and during July the rate was much less and quite irregular. From August 1 throughout the remaining months of operation of the filter the average rate of application was 500,000 gallons per acre daily, and the filter disposed of it without difficulty. The surface of the filter was not disturbed until April. During April it was raked to the depth of 3 inches once each week to April 23, and from this date until the end of the experiment to the same depth daily.

Monthly Averages of Analyses of Effluent of Filter No. 58.

[Parts per 100,000.]

1895.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
February, .	975,000	47	44	Decided.	.32	3.4000	.1433	11.08	0.01	.0040	.64	316,000
March, . .	1,011,000	50	52	Slight.	.36	2.0700	.1108	7.88	0.65	.0202	.58	43,000
April, . .	788,000	51	51	Decided.	.46	0.3400	.0613	8.59	1.73	.0090	.48	59,000
May, . .	1,014,000	62	58	Slight.	.25	0.2080	.0496	11.44	1.77	.0130	.39	115,000
June, . .	876,000	71	70	Slight.	.30	0.2555	.0490	12.82	1.66	.0180	.33	50,000
July, . .	355,000	72	69	Slight.	.30	0.1081	.0523	16.31	1.83	.0087	.28	214,000
August, .	500,000	75	70	Slight.	.25	0.0520	.0268	16.40	2.33	.0052	.21	86,000
September, .	500,000	69	68	Slight.	.21	0.0273	.0319	16.43	2.26	.0017	.20	67,000
October, .	500,000	55	56	Slight.	.24	0.0526	.0300	12.02	2.25	.0047	.22	35,000
November, .	500,000	57	54	Slight.	.29	0.0590	.0390	9.27	2.26	.0110	.27	35,000
December, .	500,000	53	54	Slight.	.20	0.0520	.0420	8.25	2.10	.0100	.23	19,500

Effluent of Filter No. 52 applied, 16⅔ gallons eighteen times a week, February 1 to May 1; 12½ gallons twenty-four times a week, May 2 to June 28; from June 29 to July 21, the amount of applied sewage varied from 3 gallons to 47½ gallons daily; 12½ gallons twelve times a week, July 22 to December 10. February 18, ½ inch of coke removed from surface of Filter No. 22 and thoroughly mixed with top foot of coke in Filter No. 58. April 15 to 21, experiment interrupted by freshet. Surface raked 3 inches deep once each week, April 1 to 22, and daily from April 23 to December 10.

Summary of Filters 51 to 58 Inclusive.

The following table gives the average analysis of the effluent of each filter for the entire period of operation : —

[Parts per 100,000.]

Number of Filter.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
51,*	608,400	-	2.1766	.3707	11.91	0.8700	.1353	2.43	620,000
52, ...	608,400	-	2.0816	.2606	12.15	0.4900	.0511	1.66	443,900
53,*	698,900	.31	.6177	.0731	12.81	2.0000	.0139	.49	75,700
54, ...	667,500	.26	.7431	.0572	12.56	1.6900	.0045	.41	11,300
55,*	681,400	.45	.8629	.0992	13.01	1.9250	.0215	.71	145,000
56, ...	694,700	.32	.8600	.0716	12.46	1.7900	.0205	.49	80,700
57,*	703,900	.36	.8366	.0768	12.58	1.6453	.0146	.50	98,200
58, ...	701,900	.30	.6573	.0594	12.22	1.6800	.0096	.36	89,300

* The filters marked with an asterisk belong to one series and those without a mark to the other. It will be observed that the series of which Filter No. 52 (coke) was the initial filter had effluents containing less organic matter and lower numbers of bacteria than the effluents of the series of which Filter No. 51 was the initial filter.

Filter No. 59.

This filter is one ten-thousandth of an acre in area, and contains, over the usual under-drains, 60 inches in depth of gravel stones of an effective size of 2.50 millimeters. Down through the middle of the filter an iron pipe 1 inch in diameter is passed, and the pipe reaches to within 6 inches of the bottom of the filter. The lower 6 inches of this pipe is perforated and to the top is attached an aspirator operated by the pressure of the city water supply. This filter was first put in operation April 1, 1895, and has received sewage at an average rate, up to Jan. 1, 1896, of 500,000 gallons per acre daily. The surface of the filter has been disturbed to a depth of 3 inches once each week and the applied sewage has uniformly disappeared immediately from the surface. From April 4 to September 2 the filter was aërated from 9 P.M. to 5 A.M. daily; from this date until November 1 the filter was not aërated; from November 1 until November 25 it was again aërated from 9 P.M. to 5 A.M.; from November 25 to December 7 there was no aëration, and from this last date to the end of the year it was again aërated from 9 P.M. to

5 A.M. When aëration was stopped in September the effluent of the filter contained 2.41 parts of nitrates in 100,000. The nitrates gradually became less and on October 30 were 1.35 parts in 100,000, and the quantity of albuminoid ammonia and oxygen consumed of the effluent had doubled. On November 12, twelve days after renewing aëration in the filter, the nitrates of the effluent had increased to 3.50 parts in 100,000 but the albuminoid ammonia and oxygen consumed of the effluent decreased very gradually. The second period of interruption of aëration did not affect the quality of the effluent. The following table gives the monthly averages of the analyses: —

Monthly Averages of Analyses of Effluent of Filter No. 59.

[Parts per 100,000.]

1895.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.			Nitrogen as			
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
April, . .	500,000	51	45	Great.	1.50	1.5000	.3300	7.38	0.00	.0000	2.30	1,848,000
May, . .	500,000	62	57	Decided.	.47	1.7440	.1440	13.18	1.41	.1760	1.02	236,000
June, . .	500,000	72	70	Decided.	.42	0.2070	.0970	13.62	2.21	.0305	0.80	225,000
July, . .	500,000	71	70	Slight.	.44	0.7200	.2050	14.99	3.21	.0152	1.10	404,000
August, . .	500,000	73	72	Decided.	.41	0.8680	.1896	14.78	2.90	.0416	0.98	444,000
September, .	500,000	69	69	Great.	.57	1.2166	.1933	14.56	1.55	.0120	1.02	511,000
October, .	500,000	56	54	Great.	.68	1.7125	.4150	11.39	1.45	.2125	2.30	520,000
November, .	500,000	54	52	Great.	.75	1.2433	.3966	10.46	2.00	.5647	2.87	716,000
December, .	500,000	45	49	Great.	.61	0.9875	.2950	7.83	2.01	.1080	1.43	317,000

Sewage applied, 54 gallons daily six days a week, April 1 to December 31. Sewage applied in the following manner: six doses of 5 gallons each applied in the forenoon and six doses of 4 gallons each in the afternoon. April 1, a piece of 1-inch pipe 5½ feet long, having holes bored in the lower 6 inches, was driven down through the center of filter; the lower end of the pipe is 6 inches above the bottom of the filter; a trap was attached to outlet. Filter aspirated eight hours each night, April 1 to September 1, November 1 to 24, December 7 to 31. April 10 to 21, experiment interrupted by freshet. April 21, 6 inches of gravel removed from filter, washed and replaced. Surface raked 3 inches deep once each week.

Filter No. 60.

This filter is one twenty-thousandth of an acre in area, and contains, over the usual under-drains, 60 inches in depth of sand of an effective size of 0.25 millimeter. To this filter has been applied, since September 8, the waste liquor resulting from cleansing rags in a paper mill by means of a boiling solution of caustic soda and lime. The rags cleaned are of all kinds and colors and the resulting liquor

is often very highly colored. It has been applied to the filter, at an average rate of 65,500 gallons per acre daily, without difficulty. The effluent of the filter, while greatly improved in appearance and analysis from the applied liquor, is still highly charged with organic matter in solution, and the degree of alkalinity of the liquor is apparently unfavorable to the development of the nitrifying organism in the filter.

Average Analysis of Liquor applied to and Effluent from Filter No. 60.

[Parts per 100,000.]

	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.		Nitrates.	Nitrites.		
Applied liquor,	2.3000	4.1000	20.00	.0000	.0000	140.00	-
Effluent,	1.0850	2.2910	12.59	.1050	.0067	84.36	3,092,000

Filter No. 61.

This filter is one twenty-thousandth of an acre in area, and contains, over the usual under-drains, 60 inches in depth of sand of an effective size of 0.25 millimeter. To this filter has been applied the waste liquor from scouring wool at an average rate, since September 8, of 17,000 gallons per acre daily. The results thus far obtained have shown that, while this liquor can be filtered through sand and a large percentage of its organic matters removed, yet it is with such difficulty, owing to clogging and necessary removal of the surface layers of the sand of the filter, that a preliminary treatment to remove a large part of the dirt and fatty matters before filtration is essential.

Average Analysis of Liquor applied to and Effluent from Filter No. 61.

[Parts per 100,000.]

	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.		Nitrates.	Nitrites.		
Applied liquor,	17.3000	43.1000	60.13	.0000	.0000	232.00	-
Effluent,	27.8000	8.3000	47.00	.2800	.0000	90.00	30,000,000

Filters Nos. VI. and VII.

Filter No. VI. contained 60 inches in depth of sand of an effective size of 0.25 millimeter, and Filter No. VII. contained the same depth of coke breeze. To these two filters the effluent of Filter No. 61 was applied at an average rate, from October 1 to January 1, of 50,000 gallons per acre daily. Each filter disposed of the applied liquor readily, but it passed through the 5 feet of filtering material with little or no change, the organic matters present being of a very stable character and the degree of alkalinity obtained prejudicial to nitrification.

Average Analyses of Effluents of Filters Nos. VI. and VII.

[Parts per 100,000.]

Number of Filter.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.		Nitrates.	Nitrites.		
VI., ...	19.5800	7.9000	72.23	.2260	.0112	76.60	264,728,000
VII., ...	21.1700	8.3900	54.06	.2200	.0260	76.10	37,472,000

Filter No. VIII.

This filter contains 5 feet in depth of sand of an effective size of 0.25 millimeter, and has received the supernatant liquid resulting from precipitating the fat and dirt out of the strong waste wool scouring liquor by means of calcium chloride. This treatment with calcium chloride gives an almost complete clarification of the liquor, and its strength after treatment, estimated by albuminoid ammonia determinations, is about the same as the effluent of Filter No. 61. Filter No. VIII. has disposed of this clarified liquor readily at an average rate of 100,000 gallons per acre daily, but it has passed through the 5 feet of sand with very little change.

Average Analysis of Effluent of Filter No. VIII.

[Parts per 100,000.]

Number of Filter.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.		Nitrates.	Nitrites.		
VIII., ...	11.1900	6.5400	65.00	.1510	.0953	53.63	720,000

FILTRATION OF WATER.

The investigations upon the purification of water by sand filtration have been continued throughout the year, and the data obtained by the results from the experimental filters at the station have been supplemented and strengthened by observations of the practical operation and the results obtained from the large filter (2.5 acres in area) of the water works of the city of Lawrence. All of the experimental filters in operation during 1894 were continued during 1895, and three new filters were constructed, containing sand of a character not before used, namely, Filter No. 62, containing 4 feet in depth of beach sand of an effective size of 0.40 millimeter; Filter No. 63, containing 2 feet in depth of "Berkshire" sand of an effective size of 0.16 millimeter, and Filter No. 64, containing 1 foot in depth of the "Berkshire" sand.

The general plan of the investigations was the same as in 1894 and the number of bacteria in the applied river water and in the effluent of each filter was determined daily. *B. prodigiosus* has been applied to all the filters in known quantities and at stated intervals, and the percentage removal of this germ by the several filters is considered to show the bacterial purification of the water, as the percentage removal of the ordinary water bacteria of the applied water shows the bacterial efficiency of the various filters, as explained in the last annual report.

The following table gives the average results obtained from the filtration of Merrimack River water during the year by the various filters: —

Summary of Average Daily Bacterial Results obtained from the Experimental Filtration of Merrimack River Water.

NUMBER OF FILTER.	Date of Construction.	Effective Size of Sand. (Millimeter.)	Uniformity Coefficient.	Depth of Material. (Inches.)	Method of Operation.	Average Rate of Filtration. Gallons per Acre Daily.	Average Number of Bacteria per Cubic Centimeter in: Applied Water.	Average Number of Bacteria per Cubic Centimeter in: Effluent.	Average Per Cent. which the Number of Bacteria in the Effluent was of the Number of Bacteria in Applied Water.	Average Bacterial Efficiency.
3 B, ...	Sept. 23, 1893,	0.23	2.3	60	Intermittent.	3,096,000	15,800	133	0.84	99.16
7 A, ...	July 20, 1894,	0.26	3.7	24	Continuous.	3,759,000	15,900	72	0.41	99.59
8 A, ...	Sept. 26, 1893,	0.23	2.3	60	Continuous.	3,576,000	15,800	43	0.27	99.73
18 A,*	Sept. 17, 1889,	0.48	2.4	60	Intermittent.	4,500,000	16,500	72	0.43	99.57
33 A, ...	April 28, 1892,	0.14	2.2	60	Continuous.	1,980,000	16,300	84	0.51	99.49
38, ...	April 28, 1892,	0.20	1.6	18	Continuous.	940,000	11,600	59	0.50	99.50
41, ...	May 9, 1892,	0.14	2.2	60	Intermittent.	1,960,000	11,600	29	0.25	99.75
42, ...	Oct. 29, 1892,	0.20	1.6	7	Continuous.	4,460,000	16,500	898	5.44	94.56
43,†	May 20, 1893,	0.26	3.7	60	Continuous.	4,680,000	16,500	191	1.16	98.84
44,†	May 20, 1893,	0.29	2.7	52	Continuous.	6,780,000	11,600	73	0.63	99.37
45,†	July 10, 1893,	0.23	2.3	57	Intermittent.	4,320,000	16,500	207	1.26	98.74
46, ...	Aug. 21, 1893,	0.29	2.3	10	Continuous.	4,480,000	11,600	122	1.05	98.95
47,†	Sept. 9, 1893,	0.29	2.4	51	Intermittent.	6,600,000	11,600	72	0.62	99.38
48, ...	Sept. 9, 1893,	0.38	3.5	51	Continuous.	4,280,000	16,500	81	0.49	99.51
49, ...	Sept. 9, 1893,	0.38	3.5	56	Continuous.	8,200,000	16,500	130	0.78	99.22
50,*	July 23, 1894,	0.48	2.4	58	Continuous.	4,680,000	16,500	92	0.55	99.45
62, ...	Sept. 2, 1895,	0.40	1.9	48	Continuous.	4,700,000	24,300	262	1.07	98.93
63, ...	Sept. 2, 1895,	0.16	2.3	24	Continuous.	4,580,000	24,300	584	2.31	97.69
64, ...	Sept. 2, 1895,	0.16	2.3	12	Continuous.	4,520,000	24,300	389	1.60	98.40

* Reduced in depth to 36 inches August 31.

† Reduced in depth to 36 inches August 1.

Discussion of Bacterial Efficiency of the Filters.

We see by this table that the average bacterial efficiency of the filters during 1895 has (excluding the results obtained from Filter No. 42, which has contained for a portion of its period of operation only 1 inch in depth of sand) varied from 97.69 per cent. on the part of Filter No. 63 to 99.75 per cent. on the part of Filter No. 41. Filter No. 63 was, in common with filters No. 62 and 64, a new filter, having been operated only three months at the time the averages were made, and containing but 2 feet in depth of sand. Excluding from the averages of the year filters Nos. 42, 62, 63 and 64, for the reasons given, the bacterial efficiency of the remaining filters — filters which had been in operation for a period during 1894 and earlier years — varies from 98.74 per cent. on the part of Filter No. 45 to 99.75 per cent. on the part of Filter No. 41. All the filters, with the exception of filters Nos. 3 B, 7 A and 8 A, are $\frac{1}{20,000}$ of an acre in area and within the buildings. These small filters cannot be operated during the winter months on account of complications from freezing, which causes the formation of channels between the body of the sand and the sides of the iron tanks, and on account of the evolution of air from the saturated water within the filters. These facts have been thoroughly explained in previous reports, and it is enough at this time to state that they are simply effects of the location of these small experimental filters and not factors in filtration. Filters Nos. 3 B, 7 A and 8 A are located out of doors and are each $\frac{1}{200}$ of an acre in area. Filter No. 3 B is an intermittent filter and Filter No. 8 A is a continuous filter, and both have been operated constantly since their construction, Sept. 23, 1893; and, although they are not protected from the weather, as filters in this climate undoubtedly should be, the results from them are probably the most important obtained at the experiment station, and illustrate more completely than the results of operation of the other filters the average yearly bacterial efficiency that can be obtained by filters containing 5 feet in depth of medium sand and operating at normal rates.

The average daily number of bacteria per cubic centimeter in the effluent of Filter No. 3 B for the year is shown by the table on page 532, and a similar table on page 538 gives the same information in regard to the effluent of Filter No. 8 A. In studying these results month by month we learn in the case of Filter No. 3 B (intermittent)

the following facts: the average bacterial efficiency of the year was 99.16 per cent., but on several occasions during the winter months the bacterial efficiency was low. On January 8 the surface of the filter was raked to the depth of 1 inch to remove clogging, and the filter was subsequently put in operation by filling from above with canal water, and on January 9 and 10 the bacterial efficiency of the filter was 91.70 and 96.50 per cent. respectively, but on no other day of the month was its efficiency less than 98 per cent. From February 6 until February 12, inclusive, owing to a frozen feed-pipe, the filter stood uncovered with water and became frozen to a considerable depth. The bacterial results of the next few days were of course poor, and should hardly be included in the yearly averages. During the winter months, up to March 11, the filter had been operated at a rate of 1,500,000 gallons per acre daily, but on this date, owing to an increased supply of water, the rate was increased to 5,000,000 gallons per acre daily, and this rate continued until November 24. For the six days following this increase of rate the bacterial efficiency averaged 94.85 per cent., but from this time throughout the remainder of the year the daily bacterial efficiency was never less than 98 per cent., and for months at a time was 99.50 per cent. or more. The comparatively low bacterial efficiency obtained at times during the winter months was largely due to the exposure of the surface of the sand to extremely cold weather, and could be avoided to a large extent with covered filters.

Studying the bacterial results of Filter No. 8 A (continuous), given in the table on page 538, we find that its daily bacterial efficiency for the year was 99.73 per cent. Throughout January and February and the first eleven days of March this filter, although exposed to the weather, gave a bacterial efficiency that was on no occasion less than 99.35 per cent. During this period the filter was operating at a rate of 1,500,000 gallons per acre daily. On March 11, owing to an increased water supply, the rate of filtration was increased to 5,000,000 gallons per acre daily, and this rate continued until November 25. For a period of eight days following this increase of rate, that is, from March 12 to 19 inclusive, the bacterial efficiency of the filter averaged 96.30 per cent., with a minimum efficiency of 92.30 per cent. From this last date until the close of the year the bacterial efficiency of the filter was never less than 98 per cent., and only on two or three occasions less than 99 per cent., and for months at a time maintained a uniform efficiency of 99.50 per cent. or more.

The bacterial results obtained from these large filters upon October 3 and 4 are significant when compared with the results obtained on these days from the small filters. On these two days the number of bacteria in the applied water was 319,000 and 110,000 per cubic centimeter, respectively, and in Filter No. 3 B, 233 and 90, Filter No. 7 A, 24 and 55, and Filter No. 8 A, 22 and 7 per cubic centimeter, respectively. The effluents of the small filters all contained a much larger number of bacteria per cubic centimeter upon these days.

Bacterial Efficiency of the Small In-door Filters.

These filters, as has been stated, can be operated only a portion of the year, and have been largely used during 1894 and 1895 in studying the bacterial results obtained from filters of different depths, material and period of operation when they are subjected to fluctuations of rate of filtration, deep scrapings, raking, etc., and have consequently been operated in many instances in a manner known to be unfavorable to the greatest average bacterial efficiency. In the tables given in a subsequent portion of this report and showing the daily bacterial efficiency of filters No. 18 to 64, inclusive, the bacterial results of those days when the filters were subjected to abnormal treatments are of samples taken before such treatment.

The average daily bacterial results of the following day were, however, necessarily affected in many instances. For this reason the results are not considered to be as representative as the results from filters Nos. 3 B and 8 A. Another complication entering into the summarizing of the results of these small filters is the fact that, in the middle of their period of operation during 1895, those containing approximately 5 feet in depth of sand were cut down to a depth of 3 feet. All of these filters, that contained at the beginning of their period of operation in 1895, 5 feet in depth of filtering material, gave a bacterial efficiency varying from 98.74 per cent. to 99.75 per cent., operating at rates of filtration varying from 2,000,000 to 7,000,000 gallons per acre daily. Filter No. 38, containing approximately 20 inches in depth of sand, and operating at an average rate of 940,000 gallons per acre daily, had a bacterial efficiency of 99.50 per cent., and Filter No. 46, containing approximately 12 inches in depth of sand, and operating at the rate of 4,480,000 gallons per acre daily, had a bacterial efficiency of 98.95 per cent.

In calculating the bacterial efficiency of these small filters the results obtained during the first ten days of their operation, or period of biological construction, are omitted.

Bacterial Purification.

The chief object of water filtration is the removal of disease germs. The results of filtration for the year, given in the preceding table and discussion, are entirely confined to the removal of the bacteria normally present in the Merrimack River water as it flows past Lawrence, after receiving the sewage of Lowell, Manchester, Concord and many other cities and towns upon its water-shed. These bacteria are of many kinds, and are chiefly those found in the wastes of human and animal life together with many whose natural habitat is the river water. To strengthen and confirm the results obtained by sand filtration of this water, it has been the custom for the past few years at the station to add at times to the water applied to the filters a pure culture of *B. prodigiosus.* The reasons for the application of this germ are that it is apparently incapable of growth within the filters and their under-drains, can be readily detected if present in the effluents, and hence its percentage removal by the filters more definitely determined than the percentage removal of the various kinds of bacteria normally present in the applied water. Some of these bacteria, we have been led to believe by results obtained in former years, are capable of multiplying within the filters, and in this manner preventing the number of bacteria present in the effluent representing the number which have passed through the entire filter. The tables showing the number of *B. prodigiosus* in the applied water and in the effluents of the various filters are given on page 529 and following pages. In studying these tables we see that the bacterial purification obtained by the various filters has been much greater than their bacterial efficiency. The bacterial purification results obtained from filters Nos. 3 B and 8 A may be summarized as follows: the rate of filtration of Filter No. 3 B was increased March 11 from 1,500,000 gallons to 5,000,000 gallons per acre daily, and on this day *B. prodigiosus* was first applied. Each cubic centimeter of applied canal water upon this day contained 617, and on the five following days 500, 970, 1,882, 870 and 244 germs of *B. prodigiosus*, respectively, and each cubic centimeter of the effluent contained on these days 5, 10, 5, 5, 2 and 1, respectively, showing an average bacterial purification for these days of 94.50 per cent. The application of *B. prodigiosus* was continued at the same rate until April 10, but only once after March 16 was its presence detected in the effluent. Such a great fluctuation of rate as that given

above, and which resulted in low bacterial efficiency and purification, is not a necessary occurrence in natural sand filtration, and the results obtained must be regarded as abnormal.

From September 2 to November 21, when the filter was operating normally at a 5,000,000 gallon rate, *B. prodigiosus* was again applied in the same proportion for ten hours daily and on only five days was its presence detected in the effluent. The bacterial purification obtained by the filter during these three months was 99.99+ per cent. This same germ was applied in the same proportion to Filter No. 8 A from March 11 to April 10, and the rate of operation of this filter was increased to the same extent on March 12 as that of Filter No. 3 B. It is of interest to note that on March 11 this germ did not appear in the effluent, but that on March 12, the day on which the rate was increased 70 per cent., the effluent contained 41 per cubic centimeter, and its presence was noted upon fifteen of the days upon which it was applied up to April 10. The average bacterial purification of the filter during the first six days of its application was 87.9 per cent. and for the remaining period up to April 10 was 99.85 per cent.

From May 6 to November 19, and from this last date until December 1, during which entire period the filter was running normally at a rate of 5,000,000 gallons per acre daily, *B. prodigiosus* was applied up to November 19 in the same proportion as during the period from March 11 to April 10, and from November 19 to December 1 in numbers twice as great, and on only five days in this entire period was its presence detected in the effluent of this filter, giving a bacterial purification of 99.99+ per cent.

Filter No. 7 A of the same area as filters Nos. 3 B and 8 A, but containing only 2 feet in depth of a somewhat coarser sand, had *B. prodigiosus* applied to it in the same proportion as to filters Nos. 3 B and 8 A ten hours daily, from August 20 to November 19 inclusive, during which period the filter was filtering at a rate of 5,000,000 gallons per acre daily, and the presence of the germ was detected in the effluent upon sixteen days. Of these sixteen days twelve were of the first three or four days following scraping to remove clogging of the surface of the filter.

The bacterial purification obtained by the small in-door filters has been uniformly greater than their bacterial efficiency.

Increased Effectiveness of Filters due to Age or Length of Period of Service.

Bacterial results have been given from time to time tending to show that the bacterial efficiency of sand filters increased in proportion to their period of service. This tendency towards increased effectiveness with increased age is made more clear by the results obtained during the past year (1895) from those filters which have been in operation at the station for several years. This increased efficiency of the filters is probably due to the accumulation of organic and mineral matter of a gelatinous character upon the sand grains of the filter, together with an increased compactness of the sand caused by a moderate amount of settling. Filter No. 18 A, the oldest filter in use at the station during 1895, and one of the two filters with greatest effective size of sand grain, was in operation during 1893 at an average rate of about 2,000,000 gallons per acre daily, and its bacterial efficiency was 96.75 per cent. During 1894 its rate of operation was 4,500,000 gallons per acre daily and its efficiency was 98.97 per cent., and during 1895 it has been operating approximately at the same rate as during 1894, and its bacterial efficiency has been 99.57 per cent. This increased bacterial efficiency caused by length of period of service is considerably more marked with filters constructed of medium coarse or coarse sands than it is with those constructed of medium fine sand. The following table of results from filters, all of which were constructed during 1893, is interesting as bearing upon this point. All of these filters contained during 1893 and 1894 5 feet in depth of sand, but Aug. 1, 1895, filters Nos. 43, 44, 45 and 46 were reduced in depth to 3 feet.

Table showing the Bacterial Efficiency of Filters during Successive Years of their Period of Service.

Number of Filter.	Date of Construction.	Effective Size of Sand. — Millimeter.	1893. Average Rate of Filtration. — Gallons per Acre Daily.	1893. Average Per Cent. which Number of Bacteria in Effluent was of Number in Applied Water.	1894. Average Rate of Filtration. — Gallons per Acre Daily.	1894. Average Per Cent. which Number of Bacteria in Effluent was of Number in Applied Water.	1895. Average Rate of Filtration. — Gallons per Acre Daily.	1895. Average Per Cent. which Number of Bacteria in Effluent was of Number in Applied Water.
43, . . .	May 20, 1893,	0.26	4,848,000	1.07	4,740,000	1.16	4,680,000	1.16
44, . . .	May 20, 1893,	0.29	4,940,000	0.60	7,370,000	0.70	6,780,000	0.63
45, . . .	July 10, 1893,	0.23	2,220,000	2.25	4,790,000	0.54	4,320,000	1.26
46, . . .	Aug. 21, 1893,	0.29	2,460,000	0.99	2,353,000	0.38	4,480,000	1.05
47, . . .	Sept. 9, 1893,	0.29	3,580,000	3.41	6,345,000	1.22	6,600,000	0.62
48, . . .	Sept. 9, 1893,	0.38	2,280,000	3.52	4,730,000	2.72	4,280,000	0.49
49, . . .	Sept. 9, 1893,	0.38	3,800,000	0.81	9,700,000	2.28	8,200,000	0.78

Effect of Different Depths of Filtering Material upon Bacterial Efficiency.

If filters 2 or 3 feet in depth can by careful supervision produce as uniformly satisfactory results from a hygienic point of view as filters containing 5 feet in depth of filtering material, their cost of construction would be materially lessened. The results attained at the station have indicated that nearly as satisfactory results are given by shallow filters as by deeper ones, especially after a period of service of some considerable length, but that they are much more sensitive to disturbing influences. This really means that if a filter in practical operation is to be supervised by experts, satisfactory and safe results can be secured with a shallow depth of sand, but that if its operation is to be entrusted to unskilled hands, not fully acquainted with the essential features of successful sand filtration, the steadying influence of a considerable depth of sand is all important. This is especially so in winter, when formation of ice and freezing of the surface sand is liable to occur, as at such times the best and most skilful handling would be necessary, with a shallow filter, to produce satisfactory results. The depth of sand in the Lawrence city filter and the method of under-draining, by which the rapidity of filtration is checked, have undoubtedly been of extreme value in producing good hygienic results.

To make a really just comparison between filters of different depths of filtering material, the filters should be of the same grade of sand, of the same period of service and should have been operated at the same rate. We can make no such absolute comparison of any of the filters in operation during 1895, but a comparison of some value can be shown by the following table of results of the three days preceding and three days following scraping the surfaces of filters Nos. 7 A and 8 A. It can also be stated that scraping the surface of Filter No. 8 A did not affect the bacterial purification results obtained, while scraping the surface of Filter No. 7 A almost invariably caused the appearance of *B. prodigiosus* in the effluent for the three or four days following.

The second table shows the number of bacteria in the effluents of these two filters at periods between scraping, when the filters were operating at approximately the same rate, namely, 5,000,000 gallons per acre daily.

Table showing the Effect of Scraping Filters Two Feet and Five Feet Deep.

Date of Scraping.	Filter No. 7 A, 2 Feet Deep. Average Number of Bacteria per Cubic Centimeter in Applied Water.		Average Number of Bacteria per Cubic Centimeter in Effluent.		Date of Scraping.	Filter No. 8 A, 5 Feet Deep. Average Number of Bacteria per Cubic Centimeter in Applied Water.		Average Number of Bacteria per Cubic Centimeter in Effluent.	
	Average of Three Days preceding.	Average of Three Days succeeding.	Average of Three Days preceding.	Average of Three Days succeeding.		Average of Three Days preceding.	Average of Three Days succeeding.	Average of Three Days preceding.	Average of Three Days succeeding.
1895.					**1895.**				
May 16, .	7,300	9,800	21	137	May 23, .	6,000	5,000	44	20
June 4, .	17,200	15,000	26	82	June 29, .	19,000	13,000	34	23
June 26, .	11,000	19,000	123	115	July 12, .	26,000	24,000	28	25
July 17, .	26,000	24,000	34	121	Oct. 17, .	15,000	6,500	12	28
Aug. 27, .	5,300	5,200	29	235	Oct. 28, .	3,500	4,000	11	6
Sept. 7, .	9,000	4,000	32	78	Nov. 12, .	4,000	-	11	17
Sept. 26, .	11,000	11,000	40	50					
Oct. 12, .	180,000	18,000	21	195					
Oct. 28, .	2,600	3,800	68	63					
Nov. 12, .	4,000	-	10	92					

Table showing the Number of Bacteria per Cubic Centimeter in the Effluent of Filters Nos. 8 A and 7 A at Periods between Scraping, when the Filters were operating at Approximately the same Rate.

Date.	Filter No. 8 A.	Filter No. 7 A.	Date.	Filter No. 8 A.	Filter No. 7 A.
July 16, ...	22	-	August 4, ...	-	-
19, ...	12	64	5, ...	96	50
20, ...	28	-	6, ...	13	74
21, ...	-	58	7, ...	10	-
22, ...	16	43	8, ...	12	-
23, ...	27	24	9, ...	8	42
24, ...	11	32	10, ...	10	35
25, ...	23	35	11, ...	-	-
26, ...	23	25	12, ...	23	24
27, ...	19	-	13, ...	16	62
28, ...	-	29	14, ...	26	63
29, ...	24	43	15, ...	19	33
30, ...	22	25	16, ...	7	27
31, ...	13	30	17, ...	13	30
August 1, ...	15	20	18, ...	-	-
2, ...	14	22	19, ...	6	38
3, ...	-	21	20, ...	6	16

On August 1, filters Nos. 43, 44, 45 and 47, which contained, when first constructed in 1893, 5 feet in depth of sand, but which had grown gradually shallower by the removal of sand at times of scraping, were cut down to the extent necessary to cause them to contain 3 feet in depth of sand over their under-drains. On August 31, filters Nos. 18 A and 50 were treated in a like manner. To reduce them to the required depth it was necessary to remove a foot or more of sand.

The purpose of this reduction in depth was to study and compare the results obtained from the same filters when of different depths, but this purpose was defeated to some extent by the fact that in removing so great a depth of filtering material, which had been rendered doubly effective by the organic matter accumulated within it, we were practically establishing new filters. The results obtained from them therefore could not in fairness be compared with the results just previously obtained, when the filters were of greater depth; neither could they be compared with results obtained during the first few months of operation of these filters, as at that time there was practically no organic matter or gelatinous films upon the sand grains, while of course on the sand remaining in the filters after their reduction in depth these gelatinous films were present to a considerable extent. It can be said, however, that these filters, after a period of biological construction, gave nearly as great bacterial efficiency under normal conditions of filtration, but were more sensitive to disturbing influences. A fairer comparison can be made between filters Nos. 46 and 47. Filter No. 46, containing approximately 12 inches in depth of sand of an effective size of 0.29 millimeter, had a bacterial efficiency for the year of 98.95 per cent., with an average rate of filtration of 4,480,000 gallons per acre daily, while Filter No. 47, containing approximately 60 inches in depth of sand of the same grade up to August 1, and after this date 36 inches in depth of sand, had a bacterial efficiency for the year of 99.38 per cent., with an average rate of filtration of 6,600,000 gallons per acre daily. From May 1 to August 1 Filter No. 46 was scraped ten times to remove clogging; the depth of sand removed at each scraping averaged 0.41 of an inch, and the average number of bacteria per cubic centimeter in the effluent for the twenty-four hours following these scrapings was 209. Filter No. 47 was scraped thirteen times to remove clogging between May 1 and August 1; the depth of sand removed each time averaged 0.33 of an inch, and the average number of bacteria in

each cubic centimeter of the effluent for the twenty-four hours following scraping averaged 86. These two filters are of the same age.

The Effect of the Amount of Loss of Head upon Bacterial Efficiency.

It has been stated in the last two reports that, contrary to some European experience, the experimental filters at Lawrence under ordinary conditions show no diminution in the removal of bacteria when the loss of head, or measurement of the frictional resistance of the sand of the filter to the passage of water, reaches nearly or quite the total depth of the filter (sand and water). The results obtained for 1895 from filters operating under normal conditions emphatically confirm the earlier ones. In studying the bacterial efficiency of the various filters when their loss of head was at or approaching its maximum, occasional results can be found giving slightly higher numbers of bacteria, but generally not enough higher to lower the bacterial efficiency of the filter more than a small fraction of one per cent. If we take the results obtained from filters Nos. 3 B, 7 A and 8 A to represent the results obtained by filters operating under normal conditions, we learn the following facts regarding this point: Filter No. 3 B was scraped ten times during 1895 to remove clogging and keep the rate to the prescribed limit; that is to say, the loss of head reached its maximum ten times, but the lowest bacterial efficiency obtained at any time upon the day immediately preceding scraping was 99.25 per cent. Filter No. 8 A was scraped sixteen times during the year, and the lowest bacterial efficiency obtained at any time upon the day immediately preceding scraping was 99.22 per cent. Filter No. 7 A contains but 2 feet in depth of sand and was scraped twelve times during its period of operation in 1895, and its lowest bacterial efficiency upon any day immediately preceding scraping was 98.90 per cent.

Effect of Fluctuation in Rate upon Bacterial Efficiency.

Under the discussion of the bacterial efficiency obtained during the year by filters Nos. 3 B and 8 A on page 506, the poor results obtained for a few days in March, following the increase of rate of each filter from 1,500,000 to 5,000,000 gallons per acre daily, has been noted. At the time when these increments of rate were made the filters had been scraped to a depth of 1 inch and then raked to a depth of 1 inch. This was a combination of factors well calcu-

lated to produce low efficiency and not necessary in actual filtration. It has been shown by the table on page 513 that scraping Filter No. 8 A had little if any effect upon its bacterial efficiency, and many thousand samples of the effluents of intermittent filters, taken after flooding and when the rates of filtration of the filters were slowly increasing to the maximum, prove that rates may be greatly increased without diminishing bacterial efficiency.

Violent fluctuations of rate, either above or below the normal, produce mechanical disturbances of the filtering materials and diminished bacterial efficiency for periods more or less prolonged.

The following table records some results obtained by fluctuating the rates of filtration. The number of bacteria per cubic centimeter in the effluents before the changes were made are given, together with the maximum number found after the change. Each set of results represents from ten to twenty bacterial analyses of samples of the effluent, most of which were collected at about the time when the water, which was in the upper portion of the filter when the rate was changed, was flowing from the filter.

Summary of Bacterial Results to show the Effect of Fluctuating the Rate of Filtration.

Number of Filter.	Date. 1895.	Changes in Rate.	Number of Bacteria per Cubic Centimeter in Effluent.	
		Million Gallons per Acre Daily.	Before Change.	After Change (Maximum).
18,	Nov. 22,	7-15	131	185
33,	Oct. 10,	-	180	426
33,	Nov. 22,	2-15	46	43
43,	Oct. 7,	5.5-19	132	148
43,	Nov. 9,	5-24-5	136	250
45,	Nov. 12,	6-16	87	95
45,	Nov 22,	6-12	96	167
48,	Oct. 9,	5-6.5	132	490
48,	Oct. 16,	5-7.5	60	92
48,	Oct. 21,	5-6	35	60
48,	Oct. 26,	5-7.5	55	81
49,	Oct. 16,	9.5-18	65	110
49,	Oct. 26,	10-12-10	64	94
50,	Oct. 7,	5-8	72	73
50,	Oct. 26,	5-14-5	93	150

In making these experiments the outlets of the filters were in most instances opened quickly and allowed to remain open, but occasionally, as with Filter No. 43 on November 9, the faucet was opened quickly, allowed to remain so for a few minutes and then closed to its original position. The experiments were all made during the months of October and November, and during October the number of bacteria in the applied canal water was unusually high. On October 10, the day on which the rate of Filter No. 33 was first fluctuated, as given in the table, the number of bacteria in the applied canal water was 298,000, and on October 9, the day on which the rate of Filter No. 48 was first fluctuated, the number in the canal water was 126,000 per cubic centimeter.

High Rates of Filtration.

The longer the investigations upon water filtration have been continued, the more evident it has become that entirely satisfactory bacterial purification of water can be obtained at rates of filtration much greater than formerly supposed. If the results obtained at the station during the past two or three years have decided anything they have certainly made this point clear. It has also been decisively settled that the bacterial efficiency of natural sand filters increases with age, and that a growing municipality that decides to filter its water supply through sand can reckon upon increasing the volume of water filtered through a given area of filter bed as the filter grows older, and obtain a bacterial efficiency equal to that obtained at the beginning of operation of its filter. Entirely satisfactory results were obtained during 1895 from filters operating at rates of 5,000,000 and even 7,000,000 gallons per acre daily. The results from filters Nos. 3 B and 8 A have been mentioned on previous pages, and the average bacterial efficiency of all the filters, together with their rates of operation, have been given in the first table of this report.

Increasing the rates of individual filters from year to year has not resulted in decreased bacterial efficiency, but the increase of period of service of these filters has been partly accountable for the entirely satisfactory results obtained. An interesting experiment has been made with filters Nos. 48 and 49. These two filters each contain approximately 5 feet in depth of sand of an effective size of 0.38 millimeter and were constructed at the same time. During 1894 and 1895 Filter No. 49 has been operated at a rate approximately

twice as great as the rate of operation of Filter No. 48, and the bacterial efficiency of these two filters, together with their rate of filtration, is given in a following table. The results are interesting as showing that a filter can be operated at a rate of more than 9,000,000 gallons per acre daily and maintain an average bacterial efficiency of more than 99 per cent.

There is one instance recorded which deserves explanation. During October, 1895, the average number of bacteria in the effluent of Filter No. 49 was 533. In order to maintain the high rate of filtration it was necessary to scrape this filter very frequently during October, and as the average number of bacteria in the applied canal water was unusually high on several occasions, they caused high numbers in the effluent. For instance, on October 3 there were 319,000 bacteria per cubic centimeter in the applied water and 2,086 in the effluent. On October 9, 12 and 15 the filter was scraped, and on these days there were 126,000, 147,000 and 17,000 bacteria per cubic centimeter in the applied water and 1,050, 4,753 and 152 bacteria per cubic centimeter in the effluent.

The filter at this time was running at an average rate of filtration of nearly 10,000,000 gallons per acre daily. Filter No. 48, operating at a rate of 5,000,000 gallons per acre daily, was much less affected by these high numbers of bacteria in the applied water.

Table to show the Relative Efficiency of Filters operating at High, as compared with those operating at Lower, Rates of Filtration.

Date.	Average Number of Bacteria in the Applied Water.	Filter No. 48.			Filter No. 49.		
		Average Rate of Filtration. — Gallons per Acre Daily.	Average Number of Bacteria in the Effluent.	Bacterial Efficiency.	Average Rate of Filtration. — Gallons per Acre Daily.	Average Number of Bacteria in the Effluent.	Bacterial Efficiency.
1894.							
July,	7,000	2,500,000	13	99.81	4,800,000	23	99.67
August,	3,600	2,520,000	19	99.47	4,980,000	17	99.53
September,	29,000	2,520,000	2	99.99	5,020,000	4	99.99
October,	36,000	3,800,000	11	99.98	7,600,000	33	99.94
1895.							
May,	7,700	4,480,000	102	98.68	9,980,000	96	98.75
June,	18,000	5,140,000	111	99.31	10,060,000	95	99.48
July,	13,000	4,940,000	89	99.32	9,580,000	17	99.67
August,	7,700	4,900,000	60	99.23	9,580,000	56	99.28
September,	10,000	4,880,000	65	99.35	9,740,000	68	99.32
October,	52,000	5,060,000	65	99.88	9,840,000	533	98.98
November,	6,800	4,760,000	73	98.93	7,280,000	42	99.39

Nearly all of the filters have been operated during 1895 at rates which would have formerly been considered abnormally high, but the good and uniform bacterial efficiency obtained at these high rates of filtration certainly go to prove that, in estimates of the cost of construction of natural sand filter beds, rates of filtration equal to four or five million gallons per acre daily can be considered safe with water of about the character of that of the Merrimack River.

The Effect of the Method of Application of Water to the Filters upon Bacterial Efficiency.

There have been in operation at the station during 1895 fourteen continuous and five intermittent water filters. To all of these filters Merrimack River water, containing a large percentage of dissolved oxygen, has been applied, and none of the filters which have contained more than 12 inches in depth of filtering material and were in operation during 1894 have given a bacterial efficiency of less than 98.74 per cent. The method of operating the intermittent filters was the same as during 1894, and as follows: at 6.30 A.M. the application of water was stopped and the filter allowed to drain for two hours from the time when the surface was first uncovered; water was then again applied and the gate of the outlet pipe kept constantly open. Operating in this way, the air drawn into the filter while the surface was uncovered and the filter was draining was largely forced downward through the outlet and much surface disturbance prevented. Taking intermittent Filter No. 3 B and its continuous mate, Filter No. 8 A, both of which were operated throughout the entire year, we find that Filter No. 8 A has given the greatest bacterial efficiency. Upon a comparison of their efficiency during different seasons of the year it is found that during weather when the temperature of the day is not, or but slightly, below the freezing point, Filter No. 3 B has given an efficiency nearly or quite equal to Filter No. 8 A. During freezing weather, however, the exposure of the surface of Filter No. 3 B has resulted in decreased efficiency at times.

Table showing Comparative Bacterial Efficiency of Intermittent and Continuous Filters at Different Seasons of the Year.

1895. Week Ending —	Bacteria per Cubic Centimeter in — The Applied Water.	Effluent of Intermittent Filter No. 3 B. 5 A.M.	9 A.M.	1 P.M.	5 P.M.	Effluent of Continuous Filter No. 8 A. 5 A.M.	11 A.M.	1 P.M.	5 P.M.
January 5, ...	16,400	24	-	34	35	15	15	19	17
12, ...	20,400	139	-	150	314	30	28	27	35
19, ...	18,500	84	-	99	100	30	37	37	61
26, ...	14,800	163	-	113	174	33	28	-	23
February 2, ...	15,300	235	-	168	158	35	24	-	44
August 3, ...	10,700	15	23	25	20	24	15	15	13
10, ...	11,000	24	18	14	14	26	44	29	20
17, ...	5,700	12	12	14	18	19	14	11	14
24, ...	6,600	9	10	13	10	16	13	13	19
December 7, ...	8,000	7	5	9	9	7	6	6	6
14, ...	7,000	11	8	11	7	5	6	6	5
21, ...	5,800	19	16	16	20	17	16	8	6

Method of Putting Filters into Operation after Scraping.

It has been the custom during the year, with the large out-door filters Nos. 3 B, 7 A and 8 A, after scraping to remove clogging, to rake the surface of the filter to a depth of 1 inch and then fill the filter slowly from below with city filtered water. The filters have then been allowed to rest for a number of hours with their surface covered with water before starting filtering again. The small iron filters, after scraping to remove clogging, have been started without raking and with canal water applied from above. The better bacterial results are obtained by the first treatment. Of the thirteen scrapings of Filter No. 3 B, ten had no appreciable effect upon the number of bacteria in the effluent, and of the seventeen scrapings of Filter No. 8 A, sixteen had no appreciable effect upon the number of bacteria in the effluent.

On Oct. 28, 1894, Filter No. 3 B was spaded over to a depth of about 6 inches for experimental purposes, and the bacterial results following this treatment are given in a table in the report of the Board for 1894, which is here repeated. The filter, after this spading over, was started by applying canal water from above.

Bacteria per Cubic Centimeter in Effluent of Filter No. 3 B.

1894.	Hour.	Bacteria.	Remarks.
November 28,	8.00 A.M.	150	Before spading.
28,	12.30 P.M.	1,680	Spading completed and water applied from the top at 10.50 A.M. Outlet gate was not closed.
28,	2.00 P.M.	2,596	
28,	3.00 P.M.	980	
28,	4.00 P.M.	1,260	
28,	6.00 P.M.	1,120	
30,	-	1,300	This and remaining numbers are averages of four analyses.
December 1,	-	735	
2,	-	-	
3,	-	596	
4,	-	346	
5,	-	339	Surface clogged again.

The average number of bacteria in the applied river water during this period was about 12,000 per cubic centimeter.

On Oct. 23, 1895, Filter No. 3 B, while operating at the same rate as in November, 1894, was again spaded over to a depth of 6 inches, but was put in operation after this treatment by filling it slowly from below with city filtered water and then allowing it to stand with its surface covered with water for two hours before again turning on the river water and opening the outlet gate. The bacterial results subsequent to this treatment are given in the following table: —

Bacteria per Cubic Centimeter in Effluent of Filter No. 3 B.

1895.	Hour.	Bacteria.	Remarks.
October 23,	8.30 A.M.	10	Before spading.
24,	8.15 A.M.	24	Outlet gate just opened after spading and filling.
24,	9.00 A.M.	48	
24,	10.00 A.M.	67	
24,	10.30 A.M.	16	
24,	10.40 A.M.	43	
24,	10.50 A.M.	21	
24,	11.00 A.M.	32	
24,	11.45 A.M.	34	
24,	1.00 P.M.	27	
24,	2.00 P.M.	30	
24,	3.00 P.M.	38	
24,	5.00 P.M.	35	
24,	7.00 P.M.	35	
25,	-	54	
26,	-	25	
28,	-	19	
29,	-	16	
30,	-	9	
31,	-	15	

Bacteria in the applied water during this period averaged 3,000 per cubic centimeter.

Summary of Results of Scraping Water Filters.

The following table summarizes the results obtained during the year in regard to the volume of water filtered between scrapings, and the approximate depths of sand removed at each scraping, for all filters whose depth remained practically the same throughout their period of operation.

Summary of Results of Scraping Water Filters during 1895.

Number of Filter.	Effective Size of Sand. (Millimeters.)	Approximate Depth of Sand. (Inches.)	Maximum Loss of Head. (Inches.)	Rate. (Gallons per Acre Daily.)	Method of Operation.	Average Depth of Sand removed at Each Scraping. (Inches.)	Average Quantity of Water filtered between Scrapings. (Gallons per Acre.)
3 B,	0.23	60	70	3,096,000	Intermittent	.60	103,000,000
7 A,	0.26	24	65	3,759,000	Continuous.	.50	75,000,000
8 A,	0.23	60	70	3,576,000	Continuous.	.60	71,000,000
33 A,	0.14	55	70	1,980,000	Continuous.	.30	40,000,000
41,	0.14	55	70	1,960,000	Intermittent.	.37	34,000,000
48,	0.38	55	70	4,280,000	Continuous.	.43	90,000,000
49,	0.38	55	70	8,200,000	Continuous.	.45	72,000,000

Chemical Purification by Filtration.

All of the suspended organic matter in the applied river water is removed by filtration and a large but variable amount of the soluble organic and coloring matters. During 1894 the average removal of color was 43 per cent., of albuminoid ammonia 55 per cent., and of oxygen consumed 44 per cent. of that in the unfiltered Merrimack River water. These results were better than those obtained during 1893 and also better than the results obtained during 1895, as shown by the following table. A summary of this table shows that the filters have removed during 1895, 30 per cent. of the color, 52 per cent. of the albuminoid ammonia and 26 per cent. of the oxygen consumed in the applied river water. The better results obtained upon the removal of color and oxygen consumed during 1894 were probably due to the fact that at the beginning of 1894 the filters were filled to their original height with new sand, and the experience of the station has been that most varieties of sands have the greatest efficiency in regard to the removal of color during the beginning of their period of use for filtration. The removal of albuminoid ammonia was practically the same as during 1894. The results for these two years indicate that old filters are as efficient as new in removing that organic matter determined as albuminoid ammonia. With the applied Merrimack River water, always containing a considerable percentage of dissolved oxygen, there was practically no difference during the year between the results obtained by intermittent as compared with continuous filtration, and dissolved oxygen has invariably been present in the effluents of the various filters, with the exception of the effluent of Filter No. 48, during a portion of September. This filter was operating at this time at a rate of 10,000,000 gallons per acre daily.

Table showing Percentages which the Color, Albuminoid Ammonia, and Oxygen consumed in the Effluents were of those in the Applied Water.

Number of Filter.	May.				June.				July.				August.			
	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.
3 B,† . .	4.3	70	49	75	3.7	60	35	67	3.8	54	40	60	3.8	50	33	53
7 A, . .	4.5	75	58	77	3.9	74	43	74	4.5	57	43	64	4.4	53	39	64
8 A, . .	4.5	70	43	73	4.2	67	30	64	4.7	57	35	62	4.4	53	38	56
18 A,† . .	5.0	82	54	77	4.4	68	46	82	4.3	61	39	62	4.3	53	44	58
33 A, . .	2.0	80	57	73	1.9	59	43	72	1.9	61	34	62	2.0	59	46	64
38, . .	1.0	80	54	77	1.0	68	41	82	1.0	61	35	62	1.0	56	47	64
41,† . .	2.3	80	49	73	2.3	52	34	64	1.9	56	31	55	1.9	56	39	56
42, . .	4.8	89	60	86	4.2	68	45	87	4.4	71	45	74	4.4	68	65	72
43, . .	5.0	91	57	82	4.8	75	45	85	4.7	71	46	76	4.9	65	38	69
44, . .	6.8	100	55	84	6.9	68	41	82	7.0	66	40	69	7.2	68	48	67
45,† . .	4.8	86	54	77	4.5	68	37	79	4.3	66	40	67	4.8	62	52	67
46, . .	5.1	91	57	98	4.6	73	45	90	4.7	71	41	76	4.6	65	59	69
47,† . .	7.0	93	58	89	6.2	73	18	87	6.3	66	41	67	6.8	68	57	69
48, . .	4.4	70	45	57	4.8	57	37	69	4.8	73	44	71	4.8	65	50	72
49, . .	10.0	68	46	59	9.4	57	39	72	9.3	76	45	74	9.3	65	48	72
50, . .	4.6	91	58	80	4.7	68	42	85	4.8	66	44	69	4.9	65	45	72
62, . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63, . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64, . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Number of Filter.	September.				October.				November.			
	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.	Rate.*	Color.	Albuminoid Ammonia.	Oxygen Consumed.
3 B,† . .	3.9	47	35	55	3.6	78	55	85	2.8	70	46	72
7 A, . .	4.1	62	41	66	4.4	65	53	76	4.3	72	51	83
8 A, . .	4.3	62	40	62	4.6	66	51	75	4.0	70	46	72
18 A,† . .	4.7	56	45	66	4.9	62	51	65	4.7	97	72	98
33 A, . .	1.9	56	38	62	1.9	54	40	56	2.0	92	55	86
38, . .	-	-	-	-	-	-	-	-	-	-	-	-
41,† . .	-	-	-	-	-	-	-	-	-	-	-	-
42, . .	4.7	65	57	69	4.7	66	63	71	-	105	76	97
43, . .	4.7	56	59	66	4.8	61	48	65	4.7	102	57	91
44, . .	-	-	-	-	-	-	-	-	-	-	-	-
45,† . .	4.6	56	43	62	4.0	61	48	63	3.8	95	55	89
46, . .	-	-	-	-	-	-	-	-	-	-	-	-
47,† . .	-	-	-	-	-	-	-	-	-	-	-	-
48, . .	4.5	56	43	66	4.9	59	45	65	4.8	85	56	98
49, . .	9.1	56	47	69	9.5	69	50	65	7.3	90	68	94
50, . .	4.7	53	43	62	5.0	65	44	66	4.9	97	63	91
62, . .	-	59	64	79	-	65	52	68	-	97	66	91
63, . .	4.5	71	60	86	4.7	66	51	71	4.7	97	62	92
64, . .	4.5	74	60	90	4.7	69	51	71	4.5	97	65	94

* Million gallons per acre daily.

† Intermittent filters.

Table showing Per Cent. which Oxygen dissolved in the Applied Water and Effluents was of that necessary for Saturation at Actual Temperature.

Month.	Canal Water.	In Effluents of Filters Nos.—																		
		3 B.*	7 A.	8 A.	18 A.*	33 A.	38.	41.*	42.	43.	44.	45.*	46.	47.*	48.	49.	50.	62.	63.	64.
1895.																				
January,	83	75	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February,	82	81	-	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March,	79	82	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April,	98	86	86	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May,	88	73	74	55	59	38	55	81	61	39	43	-	63	70	71	81	55	-	-	-
June,	62	57	24	41	48	6	8	58	38	15	14	58	24	54	44	46	35	-	-	-
July,	59	58	25	21	48	19	11	60	35	6	27	47	26	48	22	22	25	-	-	-
August,	55	69	45	19	52	5	6	58	15	11	10	32	4	19	4	5	5	-	-	-
September,	50	71	40	25	13	1	-	-	16	5	-	39	-	-	1	0	14	20	14	28
October,	68	74	30	31	56	29	-	-	42	25	-	57	-	-	20	20	23	29	27	32
November,	99	97	85	81	96	73	-	-	95	82	-	-	-	-	91	84	84	82	83	87
Averages,	75	75	53	53	53	25	20	64	43	26	24	47	29	48	36	37	38	44	41	49

* Intermittent.

The Water taken from the Merrimack River and applied to the Experimental Filters.

All the water applied to the filters during 1895 has been Merrimack River water, taken from the Essex Company's canal. During a large part of the year an abundant supply was obtained through a 12-inch iron pipe connected with the locks at the foot of the canal. This pipe is above the ground and cannot be used during winter weather, and for this reason our supply of water is more limited during cold weather, when we are dependent upon the water obtained through a 4-inch pipe from the same canal.

The results of the analyses of the water as it flows upon the filters at the station are given in the next two tables; the first giving the average daily results of two or more bacterial determinations and the second giving the monthly averages of the chemical analyses. With the latter table are given the results of bacterial analyses of samples taken at the same time that the samples for chemical analysis were taken. Their average is of course not identical with the average results of the preceding table.

Average of Daily (8 A.M. and 4 P.M.) Number of Bacteria per Cubic Centimeter in Canal Water, 1895.

Day of Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	17,600	13,000	19,000	11,000	4,000	8,000	11,000	16,000	-	3,000	5,000	-
2,	15,400	12,000	19,000	9,000	4,000	-	11,000	13,000	3,500	66,000	4,200	8,500
3,	17,000	-	-	9,000	3,000	5,500	14,000	8,000	4,000	319,000	-	4,100
4,	16,000	15,000	33,000	9,000	3,000	25,000	-	-	5,000	110,000	8,300	5,900
5,	15,000	14,000	21,000	12,000	-	20,000	13,000	18,000	13,000	45,000	3,400	9,100
6,	-	18,000	17,000	9,000	2,000	23,000	12,000	7,500	7,500	-	4,200	8,700
7,	19,000	18,000	17,000	-	4,000	12,000	-	14,000	5,000	20,000	7,200	11,700
8,	26,000	27,000	18,000	11,000	4,500	11,000	9,000	10,000	-	26,000	4,600	-
9,	22,000	18,000	34,000	5,000	3,000	-	6,500	10,000	3,500	126,000	5,800	14,600
10,	17,000	-	-	9,000	3,000	8,000	14,000	6,500	4,000	298,000	-	4,500
11,	17,000	13,000	23,000	-	12,000	8,500	21,000	-	5,500	95,000	4,000	5,000
12,	22,000	19,000	16,000	-	-	24,000	15,000	4,000	4,000	147,000	4,500	4,000
13,	-	17,000	16,000	-	4,500	40,000	24,000	4,000	4,000	-	3,900	7,800
14,	27,000	17,000	12,000	-	9,000	38,000	-	13,000	4,000	18,000	4,800	5,800
15,	16,000	16,000	18,000	-	8,000	35,000	15,000	7,000	-	17,000	4,000	-
16,	19,000	12,000	15,000	-	6,000	-	13,000	3,000	12,000	9,000	6,400	7,500
17,	14,000	-	-	-	4,500	12,000	35,000	3,000	3,000	11,000	-	5,000
18,	16,000	16,000	18,000	-	11,000	7,500	22,000	-	22,000	7,000	10,000	5,400
19,	19,000	14,000	20,000	-	-	28,000	15,000	4,000	34,000	6,500	7,800	5,900
20,	-	15,000	13,000	-	6,500	23,000	10,000	4,000	29,000	-	6,000	4,900
21,	18,000	11,000	11,000	-	5,500	27,000	-	10,000	34,000	4,500	12,000	5,900
22,	12,000	17,000	11,000	6,000	6,500	22,000	5,500	7,000	-	2,000	8,400	-
23,	15,000	10,000	12,000	5,000	6,000	-	7,000	7,500	6,000	1,300	6,000	9,500
24,	14,000	-	-	7,000	3,500	12,000	8,500	7,000	5,000	3,400	-	12,000
25,	13,000	14,000	21,000	4,000	4,000	8,000	11,000	-	16,000	5,000	5,100	-
26,	16,000	25,000	22,000	7,500	-	14,000	13,000	3,500	11,000	2,900	5,500	8,800
27,	-	17,000	27,000	4,000	9,500	15,000	5,000	8,500	13,000	-	16,000	13,700
28,	24,000	16,000	39,000	-	10,000	19,000	-	5,000	7,500	1,800	-	7,500
29,	15,000	-	12,000	4,000	14,000	22,000	4,000	7,000	-	2,300	8,300	-
30,	13,000	-	13,000	4,000	13,000	-	8,000	3,500	2,500	4,200	14,500	13,200
31,	15,000	-	-	-	9,000	-	15,000	3,500	-	2,700	-	8,300

Monthly Averages of Analyses of Canal Water (Merrimack River).

[Parts per 100,000.]

Date — 1895.	Temperature. Deg. F.	Color.	Ammonia.	Ammonia, Albuminoid.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
			Free.	Total.	Soluble.		Nitrates.	Nitrites.			
January,	34	.35	.0122	.0194	.0153	.30	.0200	.0001	.39	102	17,000
February,	32	.35	.0131	.0202	.0172	.33	.0190	.0000	.49	82	20,000
March,	36	.43	.0161	.0334	.0268	.26	.0230	.0002	.52	102	17,000
April,	39	.54	.0029	.0167	.0149	.19	.0170	.0000	.51	100	12,000
May,	61	.44	.0045	.0168	.0147	.16	.0180	.0002	.44	80	5,000
June,	71	.44	.0080	.0210	.0165	.21	.0110	.0001	.39	55	23,000
July,	72	.41	.0085	.0218	.0179	.27	.0140	.0004	.42	52	11,000
August,	73	.34	.0084	.0198	.0171	.29	.0110	.0003	.36	48	7,000
September,	71	.34	.0141	.0206	.0144	.30	.0190	.0005	.29	44	7,000
October,	51	.74	.0082	.0287	.0231	.21	.0150	.0003	.80	68	9,000
November,	44	.61	.0040	.0239	.0190	.19	.0130	.0002	.64	102	5,600
December,	35	.48	.0044	.0158	.0143	.20	.0180	.0001	.43	99	5,300

Solids in the River Water during a Freshet.

The following table records the solids in the water of the Merrimack River in April, 1895, during a period of severe freshet. The river water was very turbid, caused by a large amount of silt in suspension in it. The rapidity with which this silt settles is shown by the determinations of the solids, as given in the table, after the water had been allowed to stand in a gallon bottle for twenty-four hours, and also by allowing the water to stand in a 6-foot tube for different periods, as given in the table.

The total solids in the water on April 16 were 111 parts per 100,000 parts, and samples were taken from the river daily until April 25, when the water had returned to very nearly its normal condition.

Solids in Merrimack River Water during the Freshet of April, 1895.

Date of Sample.		Portion of Sample Taken.	Time of Settling before Determination.	Parts per 100,000.		
				Total Solids.	Loss on Ignition.	Fixed Solids.
			Hours.			
April 16,	Sample stood twenty-four hours in a gallon bottle, and was then divided into three portions by means of a syphon.	Upper 3d.	24	18.35	2.25	16.10
		Middle 3d.	24	7.55	3.70	3.85
		Lower 3d.	24	307.45	11.10	296.35
16,	Sample poured into a tube 6 feet high, 2½ inches diameter and allowed to settle. Portions syphoned off as desired.	Upper foot.	6	8.80	1.30	7.50
		Upper foot.	24	8.30	1.90	6.40
		3d foot.	6	9.80	2.20	7.60
		3d foot.	24	8.30	2.40	5.90
		5th foot.	6	10.40	2.70	7.70
		5th foot.	24	8.20	2.50	5.70
17,	Determinations made immediately after sample was taken.	-	-	45.20	8.20	37.00
18,	Determinations made immediately after sample was taken.	-	-	16.20	3.80	12.40
19,	Determinations made immediately after sample was taken.	-	-	11.10	2.70	8.40
20,	Determinations made immediately after sample was taken.	-	-	7.80	1.40	6.40
22,	Determinations made immediately after sample was taken.	-	-	7.40	2.40	5.00
23,	Determinations made immediately after sample was taken.	-	-	6.90	1.60	5.30
24,	Determinations made immediately after sample was taken.	-	-	5.30	1.30	4.00
25,	Determinations made immediately after sample was taken.	-	-	4.50	0.80	3.70

Application of Bacillus Prodigiosus.

Bacillus prodigiosus has been applied, together with the river water from the canal, to filters 3 B, 7 A, 8 A, 43, 44, 45, 48, 49, 62, 63 and 64 at different periods from March to November. The general plan of the experiments has been the same as in previous years (see annual report of the Board for 1892, page 529), except that the germ has been applied in smaller numbers. A pure culture of *B. prodigiosus* has been obtained by inoculation and growth for four days at 20° C. in a solution of one-tenth per cent. peptone and two-tenths per cent. glucose in city water. This mixture has been applied to the filters in the proportion of 1 part mixture to 170,000 parts of water, at intervals of one hour for ten hours a day and six days in a week.

Numerous examinations have been made at frequent intervals to determine whether or not this germ passed through the filters.

In order to strengthen the regular method of determination a number of tests were made (by using a large roll-tube) by which 50 cubic centimeters of effluent could be examined at a time. It is interesting to note that in no single instance in which the effluent

of Filter No. 8 A was examined by this method did a single *B. prodigiosus* appear.

In the next table are given the average numbers of *B. prodigiosus* per cubic centimeter in the applied water for ten hours during each day that this germ was applied to the filters.

Average Number per Cubic Centimeter of Bacillus Prodigiosus in Applied River Water for Ten Hours Daily, 1895.

Day of Month.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1, ...	0	653	0	1,588	494	435	0	376	318
2, ...	0	647	0	0	347	435	347	376	418
3, ...	0	541	0	400	347	382	424	288	0
4, ...	0	688	0	500	0	0	400	224	347
5, ...	0	929	0	529	400	312	435	706	365
6, ...	0	0	1,165	435	441	371	394	0	382
7, ...	0	0	847	371	0	476	382	565	465
8, ...	0	318	1,235	300	365	647	0	329	318
9, ...	0	635	1,000	0	347	400	400	288	306
10, ...	0	224	553	235	359	335	471	229	0
11, ...	617	0	406	371	429	0	529	288	341
12, ...	500	182	0	418	376	476	706	359	341
13, ...	970	0	435	529	300	429	235	0	300
14, ...	1,882	0	500	806	0	382	471	347	318
15, ...	870	0	0	594	358	482	0	341	412
16, ...	247	0	400	0	465	435	206	459	0
17, ...	0	0	529	441	418	271	0	353	0
18, ...	400	0	0	400	429	0	371	294	535
19, ...	1,047	0	0	406	394	494	318	294	500
20, ...	618	0	553	424	294	488	0	0	418
21, ...	959	0	706	471	0	406	559	365	418
22, ...	1,470	0	765	282	400	435	0	312	429
23, ...	776	0	765	0	241	288	429	318	276
24, ...	0	0	0	635	500	400	341	300	0
25, ...	894	0	576	824	576	0	176	188	347
26, ...	1,000	0	0	588	524	659	282	312	294
27, ...	0	0	412	412	576	471	288	0	359
28, ...	0	0	382	347	0	359	359	441	0
29, ...	365	0	647	612	206	376	0	459	0
30, ...	882	0	253	0	535	441	271	465	0
31, ...	0	-	1,353	-	559	406	-	412	-

Detailed Account of the Work of the Several Water Filters in 1895.

The remainder of this report upon water filtration contains a brief account of the construction and operation of each filter, the average results of daily bacterial analyses and the monthly averages of chemical analyses, together with the average bacterial results of samples taken at the same time the samples for chemical analyses were taken. The daily bacterial results are made up by averaging the results of several daily analyses in the case of filters Nos. 3 B, 7 A and 8 A.

All the in-door filters were, for reasons previously given, not operated from Dec. 1, 1894, until the spring of 1895, and all the filters were at times subjected to treatment not necessarily a part of filtration.

Filter No. 3 B.

This intermittent filter was started Sept. 23, 1893, and contained 60 inches in depth of sand of an effective size of 0.23 millimeter. The history of this filter up to Jan. 1, 1895, has been published in the annual reports of the Board. Its history during 1895 contained the following principal points.

In order to prevent the upper layers of sand from freezing during the period of intermittent operation, the gate in the canal water pipe was closed at 5 A.M. As a result of this procedure the surface of the sand became and remained uncovered for two hours during the warmest part of the day. From Dec. 29, 1894, to March 8, 1895, the prescribed rate of filtration was 1,500,000 gallons per acre daily. On March 11 this rate was increased to 5,000,000 gallons. The filter continued in operation at this rate until November 24, when the rate was decreased to 1,500,000 gallons per acre daily. On Sundays and on days following scrapings the filter ran continuously. As the water in the feed-pipe froze, the gate on the outlet was closed and the surface of the sand remained uncovered with water from February 6 to 13. High water in the river made it necessary to shut the valve again from April 11 to 13, and from April 14 to 19, though the surface of the sand was covered with water. The river silt was scraped from the surface April 20, and city water applied slowly from below on the 22d. After the surface became covered

the filter was allowed to stand full of water for forty-eight hours, and started at the usual rate April 28. On account of low water in the canal the gate on the outlet remained closed, and the surface of the sand covered with water on the following dates: March 10, 30, April 27, May 5, June 8, 16, 23, July 6, 13, 21, 25, August 3, September 22, 28 and November 23, for periods varying from twelve to thirty-six hours.

A short trap was attached to the outlet, but the lower foot of sand was not saturated. In order to remove clogging the filter was filled with city water from below on December 26, and the surface was raked to a depth of 1 inch on January 8. To remove clogging more efficiently the filter was scraped as follows: 1 inch of sand was removed on March 9 and 26; ½ inch (approximately) of sand was removed on June 25, July 31, August 26, October 1, 16, 23, November 7 and 18. After scraping, the filter was, on each occasion, raked to a depth of 1 inch, except on October 23, when it was spaded to a depth of 6 inches. On March 29 the filter was restored to its original height with new sand, after scraping. Before applying canal water the filter was filled with city (filtered) water slowly from below after scraping and allowed to stand for several hours.

A solution seeded with *Bacillus prodigiosus* was mixed with the applied canal water, in the ratio of 1 part to 170,000 parts, for ten hours a day, from March 11 to April 10, and from September 2 to November 21. Four samples of effluent collected at different hours each day (excepting Sunday) have been analyzed. Averages of these analyses, calculated for twenty-four-hour periods, are given in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 3 B, 1895.

Day.	January.	February.	March.		April.	May.	June.	July.	August.	September.		October.		November.		December.
			Water Bacteria.	B. Prodigiosus.						Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	
1, . .	42	71	194	-	74	25	27	13	-	-	-	3	-	14	0	-
2, . .	28	121	128	-	89	53	-	13	29	17	0	10	-	6	0	11
3, . .	26	-	-	-	63	34	26	24	18	7	0	233	1	-	-	4
4, . .	43	159	53	-	74	24	26	-	-	14	0	90	0	11	0	3
5, . .	24	152	254	-	53	-	24	20	29	5	0	12	0	6	0	5
6, . .	-	-	445	-	35	19	23	27	16	17	0	-	-	6	0	10
7, . .	47	-	231	-	-	21	13	-	13	5	0	37	0	9	0	12
8, . .	52	-	49	-	23	24	38	22	11	-	-	25	0	29	0	-
9, . .	1,829	-	255	-	25	27	-	33	6	9	0	13	0	11	1	3
10, . .	599	-	-	-	21	23	49	16	32	25	0	11	0	-	-	9
11, . .	251	-	1,143	5	-	32	29	28	-	7	0	13	1	13	0	20
12, . .	140	-	800	10	-	-	22	15	14	4	0	14	0	13	0	5
13, . .	-	746	1,097	5	-	17	19	16	10	6	0	-	-	9	0	6
14, . .	109	2,118	447	2	-	24	37	-	16	15	0	17	0	7	0	22
15, . .	95	1,908	974	2	-	44	25	26	12	-	-	4	0	19	0	-
16, . .	103	4,100	698	1	-	22	-	21	9	9	0	3	0	8	0	34
17, . .	90	-	-	-	-	33	30	15	7	6	0	19	0	-	-	13
18, . .	79	721	229	0	-	26	34	16	-	6	0	29	1	6	0	19
19, . .	79	513	173	0	-	-	22	20	10	10	0	55	0	15	0	10
20, . .	-	440	261	0	-	23	20	14	6	5	0	-	-	12	0	19
21, . .	111	167	77	1	-	19	27	-	8	4	0	14	0	-	-	18
22, . .	146	406	76	0	-	130	11	26	10	-	-	18	0	42	0	-
23, . .	80	157	85	0	-	36	-	15	8	16	0	6	0	64	-	7
24, . .	82	-	-	0	-	109	35	14	15	8	0	36	-	-	-	6
25, . .	225	72	28	-	58	43	43	30	-	13	0	54	-	27	-	-
26, . .	358	40	28	-	43	-	29	25	14	8	0	24	1	9	-	5
27, . .	-	451	-	-	43	55	35	21	46	16	0	-	-	7	-	11
28, . .	438	247	304	-	-	77	35	-	25	10	0	19	-	-	-	16
29, . .	243	-	168	-	62	54	24	20	19	-	-	16	-	3	-	-
30, . .	143	-	158	-	33	36	-	12	15	20	0	9	-	6	-	14
31, . .	132	-	-	-	25	39	-	16	7	-	-	15	-	-	-	9

Monthly Averages of Analyses of Effluent of Filter No. 3 B.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
January, . .	1,282,400	34	33	.24	.0187	.0088	.30	.0260	.0000	.25	75	185
February, .	1,054,200	32	32	.25	.0189	.0098	.33	.0340	.0000	.32	81	410
March, . .	2,642,600	36	32	.33	.0062	.0093	.26	.0380	.0000	.36	82	58
April, . .	2,603,000	39	36	.45	.0007	.0111	.19	.0250	.0000	.40	86	52
May, . . .	4,345,600	61	61	.31	.0005	.0083	.16	.0370	.0000	.33	73	32
June, . .	3,702,600	71	73	.26	.0004	.0074	.23	.0330	.0000	.26	57	33
July, . .	3,809,200	72	73	.22	.0006	.0088	.26	.0430	.0000	.25	58	24
August, . .	3,815,000	73	72	.17	.0004	.0065	.29	.0410	.0000	.19	69	12
September, .	3,930,800	71	69	.16	.0005	.0073	.30	.0540	.0000	.16	71	9
October, . .	3,634,800	51	48	.58	.0012	.0157	.20	.0220	.0000	.68	74	15
November, .	2,759,400	44	44	.43	.0005	.0109	.18	.0150	.0000	.46	97	8
December, .	1,018,200	35	35	.39	.0008	.0080	.20	.0270	.0000	.31	82	15

Filter No. 7 A.

This continuous filter was started July 20, 1894, and contained 24 inches in depth of sand of an effective size of 0.26 millimeter. Its history for the year 1894 has been published in the annual report of the Board. The principal features in the history of the filter during 1895 are as follows: —

After draining, the filter went out of operation for the winter on December 28, 1894. On March 24, 1895, it was filled slowly from below with city (filtered) water and allowed to stand for thirty-six hours. March 26 the filter began to filter canal water continuously at a prescribed rate of 2,000,000 gallons per acre daily. This rate was increased permanently, on May 1, to 5,000,000 gallons. July 1, for a period of sixteen hours, the filter ran at a rate of 5,250,000 gallons. A trap was attached to the filter so that the point of delivery was nearly opposite to the outlet. Owing to high water the gate on the outlet remained closed from April 10 to 13, and the surface of the sand covered with water. The gate was opened April

13 and remained open for thirty-four hours, but was closed again in consequence of high water. On April 19 the gate was opened and the filter allowed to drain until the 24th. Several inches of river silt were scraped from the surface on the 20th. City (filtered) water was applied slowly from below on April 24, until it covered the surface of the sand. Having stood full of water over night, the filter again went into operation on April 25 at the prescribed rate (5,000,000 gallons per acre daily). In consequence of low water in the canal the gate on the outlet remained closed, and the surface of the sand covered with water, for periods varying from eight to twenty-seven hours, on the following dates: March 30, April 27, May 5, June 8, 16, 23, July 6, 13, 21, August 3 and November 23.

In order to remove clogging at the surface, one-half an inch (approximately) of sand was removed from the surface of the filter by scraping on May 16, June 4, 26, July 17, August 7, 27, September 7, 26, October 12, 23, November 12 and 23. After scraping, the filter was raked to a depth of 1 inch, and then filled slowly with city (filtered) water from below. After filling with city water and before turning on the canal water the filter was allowed to stand for a period varing from eight to eighteen hours. Attention is called to the fact that this filter was scraped frequently to remove clogging during 1895, instead of being simply raked, as in 1894. After draining, the filter went out of operation November 25.

To test the bacterial efficiency of the filter four samples of effluent have been collected daily at different hours (Sundays excepted) and analyzed. Averages of these hourly samples, calculated for the whole period of twenty-four hours, are given in the record of daily analyses in the following table. A solution seeded with *Bacillus prodigiosus* was applied to the filter in the ratio of 1 part to 170,000 of the applied canal water from August 20 to November 19. A few of these organisms appeared in the effluent occasionally, as indicated in the table.

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 7 A, 1895.

Day.	April.	May.	June.	July.	August.	September.		October.		November.	
						Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1,	-	147	27	45	20	-	-	36	1	10	0
2,	-	89	-	34	22	33	-	24	0	14	0
3,	-	78	23	26	21	23	0	55	0	-	-
4,	153	69	40	-	-	127	0	44	0	15	0
5,	186	-	70	25	50	29	1	33	0	12	0
6,	146	33	110	16	74	18	0	-	-	16	0*
7,	-	37	52	-	54	55	0	19	0	17	0
8,	124	42	22	26	70	-	-	38	0	19	0
9,	105	31	-	23	42	76	12	28	0	19	0
10,	113	29	39	28	35	113	8	22	0	-	-
11,	-	25	27	29	-	38	1	24	0	10	0
12,	-	-	19	45	24	32	1	15	0	21	0
13,	-	20	18	37	62	25	0	-	-	68	0
14,	-	25	19	-	63	22	0	176	4	58	0
15,	-	12	37	47	33	-	-	165	4	74	0
16,	-	48	-	22	27	14	0	45	3	212	1
17,	-	64	38	31	30	13	0	41	0	-	-
18,	-	62	23	176	-	12	0	62	0	72	1
19,	-	-	19	107	38	27	0	91	0	51	0
20,	-	31	42	67	16	17	0	-	-	46	0
21,	-	44	21	-	17	24	0	108	0	30	0
22,	-	27	26	58	18	-	-	24	0	41	0
23,	-	30	-	43	33	274	0	37	0	60	0
24,	-	34	215	24	33	24	0	73	5	-	-
25,	1,027	30	76	32	-	37	0	70	3	-	-
26,	433	-	105	35	22	70	0	55	3	-	-
27,	97	26	140	25	65	82	41	-	-	-	-
28,	-	21	170	-	356	39	1	15	0	-	-
29,	132	12	86	29	231	-	-	15	0	-	-
30,	106	11	-	43	84	52	0	12	0	-	-
31,	147	26	-	25	38	-	-	10	0	-	-

Monthly Averages of Analyses of Effluent of Filter No. 7 A.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
March,	1,605,200	36	38	.13	.0012	.0104	.15	.1180	.0000	.17	-	560
April,	1,042,600	39	37	.47	.0040	.0128	.19	.0230	.0000	.41	86	92
May,	4,526,800	61	62	.33	.0005	.0097	.16	.0250	.0000	.34	75	43
June,	3,950,000	71	74	.29	.0004	.0090	.23	.0240	.0000	.29	21	132
July,	4,465,600	72	74	.24	.0008	.0093	.26	.0260	.0000	.27	22	39
August,	4,376,800	73	73	.19	.0005	.0078	.29	.0240	.0000	.23	39	46
September,	4,054,400	71	71	.18	.0012	.0084	.30	.0380	.0006	.19	40	23
October,	4,362,600	51	52	.52	.0011	.0151	.21	.0230	.0000	.61	30	26
November,	4,328,600	44	44	.46	.0005	.0123	.18	.0170	.0000	.53	85	36

Filter No. 8 A.

This continuous filter was started Sept. 26, 1893, and contained 60 inches in depth of sand of an effective size of 0.23 millimeter. The history of this filter up to Jan. 1, 1895, has been published in previous reports of the Board. The principal features in its history during 1895 are presented in the following paragraphs.

From Dec. 29, 1894, to March 11, 1895, the prescribed rate of filtration was 1,500,000 gallons per acre daily. On March 12 the rate was increased to 5,000,000 gallons. The filter continued in operation at this rate until November 25, when the rate was decreased to 2,000,000 gallons per acre daily. A trap was attached to the outlet. On January 31 the feed-pipe froze, and the filter remained out of service, with the surface of the sand uncovered with water, from February 1 to 6. On the 7th, city (filtered) water was applied from below until the surface became covered. After standing full of water over night the filter was started February 8. Owing to high water in the river the filter remained out of regular service from April 10 to 13, the surface of the sand being covered with water. The outlet was opened on the 13th and remained open for thirty-four hours. The filter was drained on the 19th; the river

silt was removed on the 20th; city water applied from below on the 21st until the surface was covered and the filter was then allowed to rest until the 26th. In consequence of low water in the canal the gate on the outlet remained closed and the surface covered with water on March 30, April 27, May 5, June 8, 16, 23, July 6, 13, 21, 25, August 3, 28, September 23, 28 and November 22, for periods varying from eight to thirty-six hours.

In order to remove clogging, 1 inch of sand was scraped from the surface of the filter on January 25, March 11 and 27.

After scraping on March 27 the filter was restored to its original depth with fresh sand. One-half an inch (approximately) of sand was removed by scraping on May 9, 23, June 11, 29, July 16, August 2, 20, September 2, 18, October 4, 17, 28, November 12 and December 18. After scraping, the filter was raked 1 inch deep, filled slowly with city (filtered) water from below, and allowed to stand with the surface covered by water, for periods varying from nine to thirty-four hours. On May 9, for purposes of experiment, the filter was filled with canal water from above after scraping. As the surface was found to be uncovered on February 1, 6, September 22 and December 16, city water was applied from below and the filter allowed to stand full of water for several hours. On November 10 the surface of the filter was spaded 6 inches deep.

A solution seeded with *Bacillus prodigiosus* was mixed with the applied canal water in the ratio of 1 to 170,000 parts for ten hours a day (excepting Sundays) from March 11 to April 10 and from May 6 to November 19; and in the proportion of 1 part to 85,000 parts from November 21 to December 1. Several samples were collected for bacterial analyses daily (excepting Sundays) from the effluent. Averages of these determinations, calculated for twenty-four-hour periods, will be found in the record of daily analyses in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 8 A, 1895.

Day.	January.	February.	March.		April.		May.		June.		July.		August.		September.		October.		November.		December.
			Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	
1, ...	14	18	22	-	78	2	16	-	21	0	32	0	15	0	-	-	13	0	13	0	-
2, ...	13	18	12	-	77	3	21	-	-	-	17	0	14	0	37	0	22	0	17	0	12
3, ...	16	-	-	-	60	2	20	-	23	0	12	0	9	0	5	0	7	0	-	-	6
4, ...	18	17	26	-	43	4	44	-	17	0	-	-	-	-	11	0	7	0	7	0	8
5, ...	22	41	19	-	87	1	-	-	26	0	15	0	96	0	13	0	20	0	8	0	4
6, ...	-	57	19	-	77	0	15	0	17	0	14	0	13	0	6	0	-	-	6	0	5
7, ...	22	-	16	-	-	-	14	0	18	0	-	-	10	0	13	0	18	0	5	0	3
8, ...	32	29	26	-	40	0	11	0	21	0	23	0	12	0	-	-	62	0	11	1	-
9, ...	20	100	17	-	16	0	17	0	-	-	11	0	8	0	5	0	6	0	8	0	4
10, ...	39	-	-	-	16	0	17	0	19	0	39	0	10	0	9	0	10	0	-	-	6
11, ...	42	60	101	0	-	-	16	0	16	0	19	0	-	-	11	0	29	1	14	0	6
12, ...	33	77	328	41	-	-	-	-	35	0	40	0	23	0	5	0	16	0	3	0	3
13, ...	-	34	1,225	10	-	-	18	0	41	0	12	0	16	0	9	0	-	-	12	0	8
14, ...	88	48	561	7	-	-	14	0	21	0	-	-	26	0	17	0	4	0	11	0	8
15, ...	40	42	922	1	-	-	13	0	18	0	38	0	9	0	-	-	20	0	24	0	-
16, ...	48	45	626	3	-	-	21	0	-	-	22	0	7	0	9	0	6	0	73	0	40
17, ...	32	-	-	-	-	-	12	0	33	0	10	0	13	0	11	0	5	0	-	-	7
18, ...	37	92	243	1	-	-	11	0	16	0	42	0	-	-	12	2	13	0	31	0	8
19, ...	28	96	374	1	-	-	-	-	16	0	12	0	6	0	7	0	35	0	15	0	12
20, ...	-	44	110	0	-	-	113	0	18	0	28	0	6	0	11	0	-	-	18	0	11
21, ...	31	26	102	1	-	-	144	0	25	0	-	-	11	0	8	0	16	0	15	0	9
22, ...	28	21	99	2	-	-	47	0	10	0	16	0	20	0	-	-	26	0	30	0	-
23, ...	23	18	63	0	-	-	16	0	-	-	27	0	25	0	14	1	13	0	77	-	6
24, ...	29	-	-	-	-	-	30	0	135	0	11	0	24	0	10	0	12	0	-	-	7
25, ...	39	34	27	1	29	-	13	0	70	0	23	0	-	-	23	0	8	0	29	1	-
26, ...	27	28	46	1	35	-	-	-	70	0	23	0	10	0	27	0	14	0	13	-	7
27, ...	-	24	-	-	18	-	34	0	36	0	19	0	15	0	12	0	-	-	13	-	6
28, ...	84	20	-	-	-	-	25	0	29	0	-	-	7	0	14	0	7	0	-	-	8
29, ...	56	-	63	0	31	-	21	0	18	0	24	0	11	0	-	-	6	0	6	-	-
30, ...	43	-	69	2	17	-	28	0	-	-	22	0	9	0	22	0	5	0	6	-	7
31, ...	18	-	-	-	-	-	20	0	-	-	13	0	14	0	-	-	27	0	-	-	10

Monthly Averages of Analyses of Effluent of Filter No. 8 A.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
January, . .	1,484,400	34	33	.24	.0110	.0069	.31	.0340	.0000	.25	70	36
February, .	1,296,600	32	34	.24	.0059	.0089	.33	.0370	.0000	.31	53	19
March, . .	2,914,200	36	33	.33	.0027	.0090	.26	.0420	.0000	.37	76	65
April, . .	2,615,200	39	36	.46	.0004	.0098	.19	.0230	.0000	.40	81	63
May, . . .	4,460,400	61	61	.31	.0002	.0072	.16	.0290	.0000	.32	55	20
June, . .	4,162,000	71	74	.26	.0002	.0062	.23	.0280	.0000	.25	41	25
July, . .	4,656,000	72	74	.24	.0006	.0077	.26	.0280	.0001	.26	21	32
August, . .	4,438,400	73	73	.19	.0009	.0076	.29	.0250	.0000	.20	19	20
September, .	4,335,800	71	71	.18	.0008	.0082	.30	.0360	.0009	.18	25	17
October, . .	4,455,800	51	52	.53	.0011	.0145	.21	.0230	.0000	.60	31	28
November, .	4,024,000	44	44	.45	.0005	.0110	.18	.0170	.0000	.46	81	39
December, .	1,692,000	35	36	.39	.0007	.0078	.19	.0310	.0000	.31	80	8

Filter No. 18 A.

This intermittent filter, 20 inches in diameter, was started Sept. 17, 1889, and contained 62 inches in depth of sand of an effective size of 0.48 millimeter. The history of this filter up to Dec. 31, 1894, has been published in previous reports of the Board. The principal points in its history during 1895 are as follows: —

From Dec. 1, 1894, to April 30, 1895, the filter was not operated. On May 1, after having been filled slowly from below with city (filtered) water, it was put in operation at a prescribed rate of 5,700,000 gallons per acre daily. The depth of sand in the filter was 59 inches. The period of intermittent operation was arranged in such a manner that the surface remained uncovered for two hours during the day, excepting on Sundays, when the filter ran continuously. A trap was attached to the outlet in such a manner that the point of discharge was a little below the outlet and the lower layers of the filter were not kept saturated. Owing to a stoppage in the canal water pipe the surface of the filter was found to be uncovered, and no effluent running, on May 25, June 17 and July 26. In consequence of low water the filter was not in operation from fifteen to twenty hours on June 8, July 6, 13, August 3, September 22 and 28. During these periods the surface of the sand remained covered with water.

In order to remove clogging, the filter was scraped as follows: June 24, 0.63 inch in depth of sand was removed; August 16, 0.57 inch; August 31 enough sand was removed to reduce the total depth of filtering material to 3 feet; November 5, 0.73 inch. This filter was not raked and filled with city water from below, as in the case of No. 3 B, but, as in the cases of the other small filters, canal water was applied from above after scraping. On September 13 the rate of filtration was fluctuated by closing the gate in the outlet for a minute and then opening it quickly to the usual point. On November 2 and 22 the rate was fluctuated by throwing the gate wide open for one minute and then reducing the rate quickly to the original rate.

A solution seeded with *Bacillus prodigiosus* was mixed with the applied canal water, in the ratio of 1 part to 170,000 parts, for ten hours a day, from November 19 to 23. Samples of the effluent were analyzed daily (excepting Sundays and on certain other occasions), and the record of these daily bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 18 A, 1895.

Day.	May.	June.	July.	August.	September.	October.	November.
1,	1,820	22	72	32	-	102	36
2,	1,120	-	52	47	104	-	51
3,	215	45	63	33	75	10,360	-
4,	574	22	-	-	175	-	85
5,	-	39	37	11	660	1,890	-
6,	150	18	136	24	250	-	120
7,	170	26	-	67	-	239	-
8,	126	39	43	40	-	270	45
9,	82	-	51	8	58	-	-
10,	122	29	65	18	24	-	-
11,	83	52	125	-	40	-	30
12,	-	42	148	16	80	259	80
13,	88	72	98	18	37	-	24
14,	45	68	-	24	-	130	-
15,	58	104	78	23	-	360	55
16,	45	-	65	15	39	-	-
17,	37	88	170	44	26	122	-
18,	30	58	105	-	23	136	97
19,	-	97	60	31	1,890	-	120
20,	490	65	40	14	470	-	-
21,	165	112	-	32	490	-	-
22,	70	128	45	22	-	89	-
23,	50	-	37	35	310	55	140
24,	50	143	35	13	115	-	-
25,	20	67	32	-	-	87	-
26,	-	107	25	20	155	58	-
27,	37	127	27	20	-	-	-
28,	53	172	-	26	190	-	-
29,	87	81	26	20	-	-	-
30,	63	-	42	19	-	29	-
31,	42	-	8	7	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 18 A.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	4,960,000	61	58	.36	.0002	.0090	.16	.0220	.0000	.34	61	80
June, . .	4,380,000	71	73	.30	.0006	.0096	.21	.0230	.0000	.32	44	69
July, . .	4,300,000	72	72	.25	.0005	.0086	.25	.0290	.0000	.26	43	35
August, . .	4,280,000	73	73	.18	.0005	.0088	.29	.0300	.0000	.21	45	20
September, .	4,680,000	71	70	.19	.0011	.0092	.30	.0300	.0000	.19	11	98
October, . .	4,940,000	51	53	.46	.0014	.0145	.23	.0250	.0000	.52	56	163
November, .	4,660,000	44	43	.59	.0014	.0171	.20	.0190	.0000	.63	96	120

Filter No. 33 A.

This continuous filter was started April 28, 1892, and contained 60 inches in depth of sand of an effective size of 0.14 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. The principal points for the year 1895 are as follows: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with a depth of sand of 58 inches, after having been filled slowly with city (filtered) water from below, the filter was put in operation at a prescribed rate of 2,000,000 gallons per acre daily. A trap was attached to the outlet. Owing to low water in the canal the filter was not in operation from twenty-four to thirty-nine hours on June 8, July 6, 13, August 3, September 22 and 28. For purposes of experiment the gate on the outlet pipe was closed for one minute and then opened to the original point on September 13, October 3 and 4. On October 10 the gate was thrown wide open for one minute and then closed to the usual point. The surface of the filter was scraped to remove clogging as follows: on June 24, 0.27 inch in depth of sand was removed from the surface; July 6, 0.24 inch; July 31, 0.26 inch; August 16, 0.29 inch; August 30, 0.30 inch; September 21, 0.39 inch; October 11, 0.27 inch; October 24, 0.39 inch; and November 19, 0.33 inch. After scraping, this filter was raked and filled with canal water from above and put in operation at once. A record of the daily (excepting Sundays) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 33 A, 1895.

Day.	May.	June.	July.	August.	September.	October.	November.
1,	210	35	40	39	-	17	34
2,	135	-	18	19	-	-	5
3,	70	13	21	47	26	1,610	-
4,	48	81	-	-	25	1,260	5
5,	-	30	76	75	124	340	-
6,	22	35	37	34	66	-	20
7,	44	270	-	74	-	120	-
8,	47	20	26	44	-	168	34
9,	46	-	5	45	19	-	-
10,	38	280	250	18	21	325	-
11,	24	68	72	-	24	47	23
12,	-	80	293	19	15	112	35
13,	25	34	145	28	30	-	8
14,	23	44	-	32	-	37	-
15,	28	160	68	34	-	27	46
16,	82	-	62	27	14	-	-
17,	61	98	102	26	6	35	-
18,	11	35	128	-	12	66	57
19,	-	120	44	40	79	-	19
20,	74	77	61	10	63	-	-
21,	660	34	-	43	90	-	-
22,	31	29	30	45	-	32	-
23,	31	-	34	41	154	20	15
24,	480	57	27	38	41	-	-
25,	25	490	31	-	-	51	-
26,	-	50	31	54	30	27	-
27,	30	32	21	38	-	-	-
28,	34	117	-	22	26	-	-
29,	32	62	16	16	-	-	-
30,	36	-	18	18	-	27	-
31,	45	-	31	4	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 33 A.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid		Nitrates.	Nitrites.			
May, . . .	2,020,000	61	61	.35	.0006	.0095	.17	.0230	.0000	.32	39	262
June, . .	1,860,000	71	72	.26	.0013	.0090	.24	.0230	.0007	.28	6	94
July, . .	1,860,000	72	69	.25	.0007	.0075	.26	.0280	.0009	.26	18	102
August, . .	1,960,000	73	73	.20	.0033	.0092	.30	.0140	.0012	.23	5	32
September, .	1,920,000	71	71	.19	.0016	.0078	.30	.0220	.0010	.18	1	28
October, . .	1,940,000	51	53	.40	.0009	.0115	.23	.0250	.0000	.45	29	27
November, .	1,980,000	44	47	.55	.0015	.0131	.20	.0210	.0000	.55	73	20

Filter No. 38.

This continuous filter was started on April 28, 1892, and contained 24 inches in depth of sand of an effective size of 0.20 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. The principal points in its history during 1895 are as follows: —

The depth of sand in the filter on Jan. 1, 1895, was 18 inches. From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, after having been filled slowly with city (filtered) water from below, the filter was put in operation at a prescribed rate of 1,000,000 gallons per acre daily. A trap was attached to the outlet. Owing to low water in the canal the filter was not in operation, for periods varying from thirty-four to thirty-nine hours, on June 8, July 6, 13 and August 3. The filter was allowed to stand full of water during these periods. In order to remove clogging the surface of the filter was scraped as follows: on July 31, 0.31 inch of sand was removed, and on August 21, 1 inch of sand was removed to show the effect of deep scraping. After scraping, the filter was not raked, but filled with canal water from above and put into operation at once. A sample of the effluent was collected daily (excepting Sundays) for bacterial analysis and the results are recorded in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 38, 1895.

Day.	May.	June.	July.	August.
1,	2,450	18	29	75
2,	960	-	25	29
3,	127	70	28	26
4,	168	17	-	-
5,	-	47	21	105
6,	176	26	23	6
7,	-	19	-	17
8,	-	40	68	8
9,	70	-	52	19
10,	58	240	72	9
11,	108	138	150	-
12,	-	13	175	34
13,	38	35	72	17
14,	44	350	-	18
15,	32	30	320	16
16,	35	-	80	23
17,	22	32	156	24
18,	22	27	101	-
19,	-	285	45	18
20,	50	31	68	40
21,	20	35	-	75
22,	18	90	40	30
23,	45	-	40	21
24,	350	110	47	14
25,	25	50	50	-
26,	-	59	35	41
27,	44	58	32	-
28,	34	104	-	14
29,	21	73	18	24
30,	16	-	22	-
31,	23	-	210	-

Monthly Averages of Analyses of Effluent of Filter No. 38.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	1,000,000	61	61	.35	.0004	.0091	.17	.0280	.0000	.34	58	350
June, . .	960,000	71	71	.30	.0015	.0087	.21	.0260	.0008	.32	8	27
July, . .	980,000	72	69	.25	.0015	.0077	.26	.0330	.0008	.26	10	37
August, . .	1,000,000	73	74	.19	.0033	.0093	.30	.0200	.0011	.23	6	15

Filter No. 41.

This intermittent filter was started on May 9, 1892, and contained 60 inches in depth of sand of an effective size of 0.14 millimeter. Its history up to Dec. 31, 1894, has been published in previous reports of the Board. The principal points in its history during 1895 are as follows :—

The depth of sand on Jan. 1, 1895, amounted to 58 inches. From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, after having been filled slowly with city (filtered) water from below, the filter was put in operation, filtering canal water at a rate of 2,000,000 gallons per acre daily. From that date until November 23 the surface remained uncovered for two hours during each day, excepting Sundays, when the filter ran continuously. A trap attached to the outlet prevented air from passing into the filter at that point. Owing to low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on June 8, July 6, 13 and August 3, for periods varying from thirty-three to thirty-nine hours. The surface of the filter was scraped in order to remove clogging as follows : on June 4, 0.38 inch of sand was removed; on June 18, 0.23 inch; on June 27, 0.33 inch; on July 10, 0.43 inch; on July 22, 0.37 inch; on July 30, 0.45 inch; and on August 16, 0.39 inch. After scraping, the filter was not raked nor filled with city filtered water from below, but canal water was applied at the surface. A record of daily (excepting Sundays) bacterial analyses of the effluent will be found in the following table : —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 41, 1895.

Day.	May.	June.	July.	August.
1,	310	40	60	20
2,	360	-	20	7
3,	105	23	34	11
4,	50	62	-	-
5,	-	20	7	12
6,	40	22	14	13
7,	20	14	-	6
8,	22	33	9	7
9,	24	-	64	8
10,	19	6	25	13
11,	-	24	17	-
12,	-	15	22	34
13,	64	234	22	18
14,	23	9	-	31
15,	16	23	21	20
16,	14	-	11	6
17,	25	25	7	10
18,	11	32	35	-
19,	-	56	20	7
20,	80	36	14	7
21,	40	14	-	26
22,	24	32	20	14
23,	15	-	32	4
24,	28	34	27	8
25,	33	167	27	-
26,	-	32	13	18
27,	70	12	12	-
28,	10	42	-	14
29,	17	37	37	24
30,	42	-	18	60
31,	87	-	9	-

Monthly Averages of Analyses of Effluent of Filter No. 41.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	1,960,000	61	61	.35	.0006	.0082	.17	.0260	.0000	.32	81	24
June, . . .	2,280,000	71	75	.23	.0004	.0071	.24	.0400	.0000	.25	58	26
July, . . .	1,920,000	72	69	.23	.0003	.0067	.26	.0350	.0000	.23	60	21
August, . .	1,860,000	73	73	.19	.0011	.0077	.30	.0380	.0000	.20	58	10

Filter No. 42.

This continuous filter was started Oct. 29, 1892, and contained 10 inches in depth of sand of an effective size of 0.20 millimeter. The history of the filter up to Dec. 11, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with only about 7 inches of fine sand, after having been filled slowly from below with city (filtered) water, filtration of canal water at a prescribed rate of 5,000,000 gallons per acre daily was begun. A short trap attached to the outlet prevented air from entering the filter at that point. Owing to low water in the canal the gate at the outlet remained closed and the surface of the sand covered with water on June 8, July 6, 13, August 3, and September 22 and 28, for periods varying from thirty-three to thirty-nine hours. The filter was scraped to remove clogging as follows: May 11, 0.27 inch of sand was removed; May 17, 0.21 inch; May 23, 0.32 inch; May 29, 0.29 inch; June 3, 0.30 inch; June 21, 0.30 inch; June 24, 0.27 inch; June 27, 0.21 inch; June 29, 0.34 inch; July 3, 0.27 inch; July 9, 0.29 inch; July 13, 0.24 inch; July 22, 0.33 inch; July 26, 0.32 inch; July 30, 0.24 inch; August 2, 0.30 inch; August 7, 0.24 inch; August 13, 0.24 inch; August 21, 1.36 inches; August 26, 0.30 inch; August 31, 0.26 inch; September 7, 0.35 inch; September 13, 0.28 inch; September 18, 0.24 inch; September 25, 0.24 inch; October 1, 0.17 inch; October 11, 0.24 inch; October 15, 0.20 inch; October 19, 0.30 inch; October 26, 0.26 inch; November 1, 0.30 inch; and November 11, 0.32 inch. The surface was not raked after scraping and the filter was usually filled with canal water from above; but on October 1 city water was applied from below.

This, in conjunction with the condition produced by the frequent scraping, which had reduced the fine sand to the under-drains, increased the number of bacteria in the effluent from that time on.

This is made evident in the following record of daily (excepting Sundays and on certain occasions when a sample was not taken) bacterial analyses of the effluent: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 42, 1895.

Day.	May.	June.	July.	August.	September.	October.	November.
1,	2,555	16	35	65	-	525	770
2,	1,050	-	30	102	-	-	-
3,	385	36	47	72	56	273,000	-
4,	665	47	-	-	54	-	690
5,	-	33	56	215	97	8,092	-
6,	145	18	64	81	52	-	840
7,	140	34	-	280	-	2,975	-
8,	80	20	110	110	-	5,040	250
9,	84	-	61	51	82	-	-
10,	74	22	224	48	37	-	-
11,	98	26	190	-	46	3,640	540
12,	-	52	154	37	46	6,210	-
13,	82	56	2,380	65	-	-	1,155
14,	34	245	-	37	-	1,620	-
15,	37	120	644	71	-	840	2,625
16,	20	-	280	18	38	-	-
17,	50	112	434	29	50	945	-
18,	50	75	135	-	4,200	495	42
19,	-	102	92	21	2,880	-	4,060
20,	35	65	34	40	1,680	-	-
21,	184	53	-	2,360	1,190	-	-
22,	490	130	38	2,996	-	127	-
23,	64	-	37	492	580	112	3,570
24,	40	59	40	289	210	-	-
25,	16	48	40	-	-	179	-
26,	-	40	34	57	1,032	340	-
27,	20	118	21	-	-	-	-
28,	34	80	-	140	230	810	-
29,	54	260	34	96	-	-	-
30,	50	-	29	22	-	268	-
31,	30	-	110	43	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 42.

[Parts per 100,000.]

1895.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	4,780,000	61	60	.39	.0005	.0100	.17	.0180	.0000	.38	61	140
June, . .	4,180,000	71	71	.30	.0006	.0094	.21	.0260	.0010	.34	38	44
July, . .	4,440,000	72	70	.29	.0004	.0097	.26	.0250	.0000	.31	35	96
August, . .	4,440,000	73	74	.23	.0013	.0129	.30	.0270	.0000	.26	15	50
September, .	4,440,000	71	70	.22	.0012	.0117	.30	.0310	.0000	.20	16	44
October, . .	4,700,000	51	53	.49	.0036	.0180	.23	.0240	.0002	.57	42	2,576
November, .	4,680,000	44	46	.64	.0040	.0182	.20	.0190	.0000	.62	95	2,450

Filter No. 43.

This continuous filter was started on May 30, 1893, and contained 60 inches in depth of sand of an effective size of 0.26 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history for 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with a depth of fine sand equal to 57 inches, and after having been filled slowly from below with city (filtered) water, the filter began to filter canal water at a prescribed rate of 5,000,000 gallons per acre daily. A short trap attached to the outlet prevented air from entering the filter at that point. Owing to low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on June 8, July 6, 13, August 3, and September 22 and 28, for periods varying from twenty-four to thirty-nine hours. In order to remove clogging the surface was scraped as follows: on June 19, 0.20 inch of sand was removed; on June 27, 0.60 inch; on July 29, 0.38 inch; on August 1, enough sand was removed to reduce the total depth of filtering material to 36 inches; on August 27, 0.53 inch; on September 9, 0.50 inch; on September 20, 0.45 inch; on October 3, 0.39 inch; on October 16, 0.47 inch; on October 25, 0.49 inch; on November 7, 0.42 inch; on November 19, 0.49 inch. The surface was not raked after scraping and the filter was usually filled with canal water from above, but on August 1, October 25 and November 7, city (filtered) water was applied below.

The rate of filtration was fluctuated as follows: on September 7 and 30 the gate on the outlet was closed for one minute and then opened to the usual point; on October 7 the gate was thrown wide open for one minute and then closed to the usual point.

A record of the daily (excepting Sundays and on certain other days) bacterial analyses of the effluent will be found in the following table. It should be noted that, of the mixture of *Bacillus prodigiosus* which was applied to the filter in the ratio of 1 part of solution in 170,000 parts of applied water, a few cells occasionally appeared in the effluent.

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 43, 1895.

Day.	May.	June.		July.		August.		September.		October.		November.	
		Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1, . .	4,760	36	-	60	0	310	0	-	-	60	1	29	1
2, . .	1,127	-	-	32	0	840	32	-	-	-	-	-	-
3, . .	315	47	-	86	0	240	3	30	3	4,690	0	-	-
4, . .	274	38	-	-	-	-	-	74	6	-	-	45	0
5, . .	-	30	-	68	6	232	0	110	0	317	0	-	-
6, . .	385	16	-	60	0	120	0	70	0	-	-	27	0
7, . .	234	90	-	-	-	218	13	-	-	154	3	-	-
8, . .	175	38	-	182	1	102	8	-	-	163	1	145	0
9, . .	150	-	-	74	3	66	2	60	1	-	-	-	-
10, . .	123	102	5	525	5	65	16	39	12	-	-	-	-
11, . .	135	34	6	189	0	-	-	35	6	-	-	110	0
12, . .	-	92	0	360	0	45	11	46	0	504	0	-	-
13, . .	328	120	0	180	14	44	12	-	-	-	-	47	0
14, . .	90	148	0	-	-	32	6	-	-	510	0	-	-
15, . .	56	2,880	0	280	0	69	0	-	-	105	0	78	0
16, . .	14	-	-	120	0	33	4	3	0	-	-	-	-
17, . .	41	91	0	455	1	37	13	23	4	108	0	-	-
18, . .	21	73	0	120	0	-	-	480	7	68	0	70	0
19, . .	-	480	0	92	23	42	4	735	7	-	-	157	0
20, . .	770	210	0	56	0	75	3	280	0	-	-	-	-
21, . .	35	161	0	-	-	41	5	126	0	-	-	-	-
22, . .	15	92	0	63	7	43	30	-	-	71	0	-	-
23, . .	54	-	-	47	0	58	60	155	4	30	0	122	0
24, . .	54	120	0	58	0	53	2	51	0	-	-	-	-
25, . .	31	140	9	85	0	-	-	-	-	-	-	-	-
26, . .	-	270	0	30	5	72	8	158	0	-	-	-	-
27, . .	60	190	20	21	3	-	-	-	-	-	-	-	-
28, . .	75	285	14	-	-	38	0	95	0	46	2	-	-
29, . .	21	2,380	0	38	0	27	3	-	-	-	-	-	-
30, . .	35	-	-	27	0	35	6	-	-	48	0	-	-
31, . .	10	-	-	38	0	24	0	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 43.

[Parts per 100,000.]

1895.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
May,	4,960,000	61	63	.40	.0005	.0096	.17	.0230	.0000	.36	39	144
June,	4,760,000	71	71	.33	.0009	.0094	.19	.0230	.0001	.33	14	92
July,	4,740,000	72	71	.29	.0019	.0100	.29	.0260	.0013	.32	6	65
August,	4,860,000	73	74	.22	.0019	.0117	.30	.0250	.0004	.25	11	77
September,	4,660,000	71	71	.19	.0018	.0078	.30	.0340	.0008	.19	5	49
October,	4,760,000	51	54	.45	.0011	.0137	.23	.0250	.0000	.52	25	107
November,	4,700,000	44	45	.62	.0019	.0136	.20	.0200	.0000	.58	82	92

Filter No. 44.

This continuous filter was started May 20, 1893, and contained 60 inches in depth of sand of an effective size of 0.29 millimeter. The history of this filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not operated. On May 1, 1895, with a depth of sand equal to 52 inches, after having been filled slowly from below with city water, filtration of canal water was begun at a prescribed rate of 7,000,000 gallons per acre daily. A short trap attached to the outlet prevented air from entering at that point. Owing to low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on May 5, 18, June 8, July 6, 13, and August 3, for periods varying from seven to thirty-nine hours. In order to remove clogging, the surface was scraped as follows: May 25, 0.40 inch of sand was removed; June 12, 0.31 inch; June 29, 0.48 inch; June 22, 0.22 inch; July 5, 1.06 inches; July 16, 0.36 inch; July 22, 0.26 inch: July 26, 0.44 inch; July 31, 0.34 inch; on August 1, enough sand was removed to reduce the depth of filtering material to 36 inches; on August 21, 0.40 inch; on August 28, 0.45 inch. The surface was not raked after scraping and the filter was filled usually with canal water from above, but on July 31 city (filtered) water was applied below until the surface of the sand was covered with water before canal water was applied.

Bacillus prodigiosus mixture was applied to this filter from July 9 to 22 in the proportion of 1 part solution in 170,000 parts of applied water. A record of the daily (excepting Sundays and certain other days) bacterial analyses of the effluent will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 44, 1895.

Day.	May.	June.		July.	August.
		Water Bacteria.	B. Prodigiosus.		
1,	3,570	24	-	63	110
2,	315	-	-	38	250
3,	280	26	-	31	150
4,	240	20	-	-	-
5,	-	35	-	38	104
6,	364	23	-	50	48
7,	95	34	-	-	85
8,	92	17	-	48	39
9,	95	-	-	42	39
10,	130	65	0	50	28
11,	107	40	0	98	-
12,	-	32	0	114	21
13,	79	70	0	128	18
14,	60	75	0	-	65
15,	36	55	0	110	45
16,	36	-	0	94	29
17,	70	38	0	350	17
18,	86	38	0	52	-
19,	-	95	0	54	38
20,	350	53	0	35	30
21,	95	40	0	-	27
22,	72	88	0	41	31
23,	35	-	-	19	22
24,	262	72	-	24	31
25,	33	90	-	60	-
26,	-	180	-	49	38
27,	27	86	-	49	-
28,	41	74	-	-	41
29,	45	122	-	26	38
30,	23	-	-	20	-
31,	65	-	-	110	-

Monthly Averages of Analyses of Effluent of Filter No. 44.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	6,820,000	61	64	.44	.0005	.0093	.17	.0190	.0000	.37	43	179
June, . . .	6,880,000	71	71	.30	.0008	.0086	.21	.0310	.0009	.32	14	37
July, . . .	6,960,000	72	69	.27	.0003	.0087	.26	.0330	.0000	.29	27	45
August, . . .	7,160,000	73	74	.23	.0004	.0096	.30	.0290	.0003	.24	10	39

Filter No. 45.

This intermittent filter was started July 10, 1893, and contained 60 inches in depth of sand of an effective size of 0.23 millimeter. The history of this filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with a depth of sand of 57 inches, after having been filled with city (filtered) water from below, the filter began to filter canal water at a prescribed rate of 5,000,000 gallons per acre daily. The period of intermittent operation was arranged in such a manner that the surface of the sand remained uncovered for two hours during the day, excepting on Sundays, when the filter ran continuously. A trap attached to the outlet prevented air from entering at that point. On May 25 a stoppage in the pipe cut off the applied water, and the surface remained uncovered for twenty-seven hours. Owing to low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on the following dates: May 5, June 8, July 6, 13, August 3, September 22 and 28, for periods varying from twenty-four to thirty-nine hours. In order to remove clogging the surface was scraped as follows: on May 29, 0.36 inch of sand was removed; June 14, 0.42 inch; June 25, 0.52 inch; July 5, 0.46 inch; July 22, 0.36 inch; July 29, 0.32 inch; on August 1, enough sand was removed to reduce the filtering material to 36 inches; August 30, 0.60 inch; September 20, 0.60 inch; October 15, 0.54 inch; November 1, 0.42 inch; November 19, 0.44 inch. The surface was not raked after scraping, and the filter was filled immediately with canal water from above.

The rate of filtration was fluctuated as follows: on October 4 the gate on the outlet was closed for one minute and then opened to the usual point; on November 12 the gate was opened a little wider than usual, and on November 22 the gate was thrown wide open for one minute and then closed to the usual point.

Bacillus prodigiosus mixture was applied to this filter from June 22 until November 22, in the ratio of 1 part to 170,000 parts of applied canal water. The following table contains a record of the daily (excepting Sundays and on certain other occasions) bacterial analyses of the effluent from this filter: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 45, 1895.

Day.	May.	June.		July.		August.		September.		October.		November.	
		Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1, . .	1,505	28	-	14	0	560	0	-	-	57	6	46	1
2, . .	525	-	-	140	1	1,140	0	-	-	-	-	-	-
3, . .	160	32	-	5	0	283	14	24	0	2,170	0	-	-
4, . .	152	36	-	-	-	-	-	34	0	4,400	0	75	3
5, . .	-	52	-	7	0	82	9	59	0	1,029	0	-	-
6, . .	38	20	-	24	0	87	0	64	10	-	-	30	0
7, . .	62	112	-	-	-	135	0	-	-	326	1	-	-
8, . .	23	16	-	14	0	122	0	-	-	210	0	54	7
9, . .	44	-	-	45	0	57	3	35	5	-	-	-	-
10, . .	32	20	-	27	0	32	10	27	0	-	-	-	-
11, . .	30	30	-	18	0	-	-	21	0	-	-	52	0
12, . .	-	26	-	43	0	-	-	10	0	325	7	75	1
13, . .	37	50	-	118	0	46	0	-	-	-	-	87	0
14, . .	30	340	-	-	-	23	0	-	-	-	-	-	-
15, . .	25	148	-	54	0	42	0	-	-	990	0	280	2
16, . .	57	-	-	24	0	18	0	9	0	-	-	-	-
17, . .	16	27	-	43	0	22	0	14	0	163	0	-	-
18, . .	12	23	-	64	0	-	-	12	0	195	7	65	0
19, . .	-	140	-	24	0	36	0	70	0	-	-	114	3
20, . .	10	36	-	70	0	4	0	520	27	-	-	-	-
21, . .	21	24	-	-	-	25	0	475	3	-	-	-	-
22, . .	21	40	-	65	2	30	0	-	-	125	7	-	-
23, . .	12	-	-	22	0	19	0	180	0	43	0	92	2
24, . .	37	8	0	9	0	26	0	80	2	-	-	-	-
25, . .	1,309	57	4	14	0	-	-	-	-	56	0	-	-
26, . .	-	31	0	14	0	12	0	104	4	-	-	-	-
27, . .	2,580	24	0	21	0	-	-	-	-	-	-	-	-
28, . .	2,450	25	0	-	-	8	0	162	1	33	1	-	-
29, . .	840	9	0	30	0	16	0	-	-	-	-	-	-
30, . .	72	-	-	21	0	114	1	-	-	13	0	-	-
31, . .	47	-	-	10	0	58	11	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 45.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	4,800,000	61	63	.38	.0006	.0091	.17	.0270	.0000	.34	–	50
June, . .	4,460,000	71	72	.30	.0005	.0077	.18	.0340	.0000	.31	58	32
July, . .	4,280,000	72	69	.27	.0005	.0088	.26	.0330	.0000	.28	47	36
August, . .	4,760,000	73	72	.21	.0003	.0103	.30	.0280	.0000	.24	32	53
September, .	4,580,000	71	71	.19	.0004	.0089	.30	.0320	.0000	.18	39	45
October, . .	4,020,000	51	53	.45	.0011	.0139	.23	.0270	.0000	.50	57	127
November, .	3,780,000	44	44	.58	.0010	.0132	.20	.0270	.0000	.57	60	72

Filter No. 46.

This continuous filter was started on Aug. 21, 1893, and contained 12 inches in depth of sand of an effective size of 0.29 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not operated. On May 1, with a depth of sand of 10 inches, after having been filled slowly with city water from below, canal water was applied continuously at a prescribed rate of 5,000,000 gallons per acre daily. A trap attached to the outlet prevented air from entering at that point. Owing to low water in the canal the gates on the outlet remained closed and the surface of the sand covered with water on the following dates: June 8, July 6, 13, and August 3, for periods varying from thirty-three to thirty-nine hours. In order to remove clogging the surface was scraped as follows: on May 23, 0.57 inch of sand was removed; on June 4, 0.48 inch; on June 17, 0.32 inch; on June 22, 0.38 inch; on June 26, 0.43 inch; on July 2, 0.39 inch; on July 10, 0.35 inch; on July 20, 0.47 inch; on July 26, 0.35 inch; on July 31, 0.35 inch; on August 6, 0.35 inch; on August 13, 0.41 inch; on August 21, 0.38 inch; on August 29, 0.49 inch. After scraping, the filter was not raked, but canal water was applied immediately from above. A record of daily (excepting Sundays and on a few other occasions) bacteria analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 46, 1895.

Day.	May.	June.	July.	August.
1,	2,170	50	34	64
2,	665	-	52	145
3,	350	55	95	62
4,	250	120	-	-
5,	-	62	86	130
6,	187	58	50	78
7,	162	50	-	235
8,	139	52	138	90
9,	72	-	113	61
10,	54	155	500	59
11,	95	43	240	-
12,	-	95	285	27
13,	62	180	325	65
14,	92	127	-	116
15,	40	89	240	74
16,	85	-	225	30
17,	31	258	511	19
18,	24	160	125	-
19,	-	210	110	35
20,	35	228	60	37
21,	34	105	-	1,330
22,	44	642	38	302
23,	60	-	42	295
24,	30	103	114	224
25,	25	66	49	-
26,	-	130	42	38
27,	80	95	68	-
28,	24	170	-	176
29,	110	71	64	150
30,	50	-	38	-
31,	60	-	228	-

Monthly Averages of Analyses of Effluent of Filter No. 46.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	5,080,000	61	60	.40	.0005	.0096	.17	.0200	.0000	.43	63	96
June, . . .	4,620,000	71	71	.32	.0003	.0094	.21	.0260	.0000	.35	24	78
July, . . .	4,660,000	72	70	.29	.0005	.0090	.26	.0280	.0000	.32	26	106
August, . .	4,620,000	73	74	.22	.0011	.0117	.30	.0280	.0000	.25	4	54

Filter No. 47.

This intermittent filter was started Sept. 9, 1893, and contained 60 inches in depth of sand of an effective size of 0.29 millimeter. Its history up to Dec. 31, 1894, has been published in previous reports of the Board. The history of the filter during 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with a depth of sand of 51 inches, after having been filled slowly from below with city water, filtration of canal water was begun at a rate of 7,000,000 gallons per acre daily. The period of intermittent operation was arranged in such a manner that the surface remained uncovered for two hours during the day. A trap attached to the outlet of the filter prevented air from entering at that point. Owing to low water in the canal the gate on the outlet remained closed on the following dates: June 8, July 6, 13 and August 3, for periods varying from thirty-three to thirty-nine hours. In order to remove clogging the surface was scraped as follows: on May 17, 0.30 inch of sand was removed; on May 30, 0.45 inch; June 8, 0.35 inch; June 19, 0.30 inch; June 21, 0.44 inch; June 25, 0.37 inch; on June 29, 0.32 inch; July 2, 0.31 inch; July 6, 0.30 inch; July 11, 0.28 inch; July 17, 0.29 inch; July 24, 0.37 inch; July 27, 0.24 inch; on August 1 the filtering material was reduced to 36 inches in depth; August 16, 0.34 inch; August 27, 0.48 inch. After scraping, the surface was not raked, but canal water was applied immediately from above. On July 29 the filter

was filled with city water from below. A record of the daily (excepting Sundays and on certain other occasions) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 47, 1895.

Day.	May.	June.	July.	August.
1,	3,570	52	44	450
2,	450	-	31	221
3,	368	19	48	148
4,	350	44	-	-
5,	-	24	43	97
6,	124	22	68	57
7,	143	35	-	52
8,	106	60	23	38
9,	101	-	16	28
10,	123	70	80	25
11,	89	10	120	-
12,	-	14	95	18
13,	60	112	420	35
14,	83	64	-	40
15,	180	82	75	23
16,	42	-	45	17
17,	70	75	390	25
18,	48	49	135	-
19,	-	110	91	14
20,	60	57	71	14
21,	36	68	-	13
22,	41	140	34	44
23,	34	-	55	27
24,	24	37	32	54
25,	67	31	41	-
26,	-	61	35	31
27,	34	74	13	-
28,	23	43	-	40
29,	15	82	22	46
30,	35	-	55	55
31,	30	-	29	-

Monthly Averages of Analyses of Effluent of Filter No. 47.

[Parts per 100,000.]

1895.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
May, . . .	7,020,000	61	64	.41	.0003	.0097	.17	.0220	.0000	.39	71	84
June, . .	6,160,000	71	71	.32	.0004	.0038	.21	.0260	.0000	.34	44	52
July, . .	6,260,000	72	72	.27	.0007	.0090	.29	.0480	.0000	.28	48	57
August, . .	6,760,000	73	73	.23	.0008	.0112	.30	.0280	.0000	.25	19	37

Filter No. 48.

This continuous filter was started Sept. 9, 1893, and contained 60 inches in depth of sand of an effective size of 0.38 millimeter. The history of this filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to May 15, 1895, the filter was not in operation. On May 16, 1895, it was filled slowly with city water from below. On May 17, with a depth of sand equal to 51 inches, it began to filter city (filtered) water continuously at a rate of 5,000,000 gallons per acre daily. On June 17 the city water was shut off and canal water applied from that date until November 23, when the canal water was shut off and city (filtered) water again applied for one week. A trap attached to the outlet prevented air from entering the filter at that point. Owing to low water in the canal the gate on the outlet remained closed, and the surface of the sand covered with water on the following dates: June 8, July 6, 13, August 3, September 22 and 28, for periods varying from twenty-four to forty hours. In order to remove clogging the surface of the sand was scraped as follows: July 17, 0.57 inch of sand was removed; August 9, 0.38 inch; August 21, 0.40 inch; September 4, 0.45 inch; September 16, 0.39 inch; September 28, 0.40 inch; October 15, 0.44 inch; October 30, 0.68 inch; November 13, 0.37 inch; November 19, 0.26 inch. After scraping, the surface was not raked, and canal water was applied at the top immediately. November 13 the surface was dug over 6 inches deep, after scraping, and on November 19, city (filtered) water was applied slowly from below until the surface of the sand was covered with water.

The rate of filtration was fluctuated as follows: on September 14 the gate on the outlet was closed for one minute and then opened to the usual point; on October 9 the gate was thrown wide open, and on October 16, 21, 26, the gate was opened a little wider than usual for one minute and then closed to the usual point.

In order to test the bacterial efficiency of the filter a solution seeded with *Bacillus prodigiosus* was mixed with the applied canal water in the ratio of 1 part to 170,000 parts, for ten hours a day, from June 10 to November 23. A record of the daily (excepting Sundays and on certain other occasions) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 48, 1895.

Day.	May.	June.		July.		August.		September.		October.		November.	
		Water Bacteria.	B. Prodigiosus.	Water Bacteria	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1, . . .	-	86	-	31	0	75	0	-	-	56	1	11	0
2, . . .	-	-	-	24	2	44	0	-	-	-	-	-	-
3, . . .	-	29	-	25	0	46	0	54	34	1,750	0	-	-
4, . . .	-	26	-	-	-	-	-	41	0	-	-	9	0
5, . . .	-	126	-	48	0	114	0	62	0	180	0	-	-
6, . . .	-	32	-	51	0	46	0	43	4	-	-	11	0
7, . . .	-	45	-	-	-	69	0	-	-	21	27	-	-
8, . . .	-	39	-	125	1	41	0	-	-	110	1	106	0
9, . . .	-	-	-	50	0	75	0	42	0	350	0	-	-
10, . . .	-	95	0	120	0	46	0	37	0	-	-	-	-
11, . . .	-	83	0	118	0	-	-	30	0	-	-	26	0
12, . . .	-	24	0	144	0	54	0	32	0	245	0	-	-
13, . . .	-	24	1	102	0	70	0	-	-	-	-	145	0
14, . . .	-	320	0	-	-	21	0	10	0	71	0	-	-
15, . . .	-	120	0	390	2	29	0	-	-	140	0	114	0
16, . . .	-	-	-	55	0	22	0	28	0	-	-	-	-
17, . . .	2,394	72	0	372	0	51	0	18	0	62	0	-	-
18, . . .	900	131	0	195	0	-	-	132	1	66	0	95	0
19, . . .	-	127	0	127	0	20	1	185	0	-	-	98	0
20, . . .	1,260	112	0	30	0	45	0	89	0	-	-	-	-
21, . . .	420	170	0	-	-	250	0	48	1	32	0	-	-
22, . . .	476	112	0	35	0	116	0	-	-	40	1	-	-
23, . . .	595	-	-	38	0	54	0	146	1	18	0	111	2
24, . . .	770	94	0	20	0	52	0	78	0	-	-	-	-
25, . . .	406	540	0	70	1	-	-	-	-	42	0	-	-
26, . . .	-	126	0	35	0	15	0	106	0	-	-	-	-
27, . . .	42	56	0	38	0	-	-	65	0	-	-	-	-
28, . . .	132	102	0	-	-	39	0	65	0	33	0	-	-
29, . . .	116	71	0	34	0	31	0	-	-	-	-	-	-
30, . . .	125	-	-	44	0	20	5	-	-	78	0	-	-
31, . . .	97	-	-	25	0	18	-	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 48.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May,	4,420,000	61	56	.31	.0002	.0076	.21	.0480	.0000	.25	77	770
June,	4,800,000	71	67	.25	.0005	.0077	.24	.0380	.0000	.27	42	164
July,	4,780,000	72	69	.30	.0004	.0096	.26	.0320	.0000	.30	22	122
August,	4,760,000	73	74	.22	.0042	.0099	.30	.0290	.0013	.26	4	34
September,	4,520,000	71	70	.19	.0017	.0088	.30	.0300	.0009	.19	1	55
October,	4,900,000	51	53	.44	.0011	.0130	.23	.0260	.0000	.52	20	64
November,	4,760,000	44	45	.52	.0018	.0134	.22	.0200	.0000	.63	108	11

Filter No. 49.

This continuous filter was started Sept. 9, 1893, and contained 60 inches in depth of sand of an effective size of 0.38 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to May 15, 1895, the filter was not in operation. On May 16, 1895, it was filled slowly from below with city (filtered) water and allowed to stand over night. On May 17, with 56 inches in depth of sand it began to filter city (filtered) water continuously at a rate of 10,000,000 gallons per acre daily. June 17 the city water was shut off and canal water applied regularly until November 23, when the city water was turned on again for one week. A short trap attached to the outlet prevented air from entering at this point. The surface of the sand became uncovered on May 21, therefore the filter was filled from above, the gates closed and the filter allowed to rest for fourteen hours. On account of low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on the following dates: June 8, July 6, 13, August 3, September 22 and 28, for periods varying from twenty-four to forty hours. In order to remove clogging the surface of the filter was scraped as follows: on June 30, 0.45 inch of sand was removed; July 13, 0.52 inch; July 22, 0.44 inch; July 27, 0.38 inch; July 30, 0.41 inch; August 3, 0.47 inch; August 9, 0.54 inch; August 14, 0.39 inch; August 21, 0.34 inch; August 23, 0.37 inch; September 5, 0.44 inch; September 9, 0.47 inch; September 12, 0.68 inch; September

25, 0.42 inch; September 30, 0.32 inch; October 9, 0.48 inch; October 11, 0.20 inch; October 15, 0.27 inch; October 24, 0.58 inch; October 30, 0.68 inch; November 2, 0.63 inch; November 5, 0.68 inch; November 9, 0.24 inch; and November 19, 0.30 inch. After scraping, the filter was not raked, and canal water was applied above immediately. On November 9 the surface was dug over 6 inches, and on November 18, after filling from above with canal water, the filter stood for an hour, after scraping, before being put into operation.

The rate of filtration was fluctuated as follows: on September 14 the gate was opened a little wider than usual, and on October 21 the gate was thrown wide open for one minute and then closed to the usual point. A solution seeded with *B. prodigiosus* was applied, as in the case of Filter No. 48.

A record of the daily (excepting Sundays and on certain other occasions) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 49, 1895.

Day.	May.	June.		July.		August.		September.		October.		November.	
		Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1, . .	-	77	-	64	0	38	0	-	-	37	6	25	0
2, . .	-	-	-	34	2	35	0	-	-	-	-	39	0
3, . .	-	51	-	63	0	68	0	44	0	2,086	0	-	-
4, . .	-	40	-	-	0	-	-	50	12	-	-	29	0
5, . .	-	53	-	45	0	75	0	44	0	171	1	36	2
6, . .	-	30	-	42	0	40	0	82	20	-	-	21	0
7, . .	-	57	-	-	0	70	0	-	-	85	0	-	-
8, . .	-	57	-	180	0	56	0	-	-	93	0	47	0
9, . .	-	-	-	56	12	52	0	35	3	1,050	40	-	-
10, . .	-	75	0	185	1	38	9	41	0	390	6	-	-
11, . .	-	36	0	122	0	-	-	24	4	104	2	36	0
12, . .	-	39	0	128	0	24	0	31	0	4,753	12	-	-
13, . .	-	62	0	504	0	85	9	-	-	-	-	30	0
14, . .	-	38	0	-	-	28	3	27	18	148	1	-	-
15, . .	-	44	0	310	0	27	13	-	-	152	0	14	0
16, . .	-	-	-	70	0	26	0	15	10	-	-	-	-
17, . .	4,539	295	16	287	1	87	0	15	1	66	0	-	-
18, . .	1,015	289	5	74	8	-	-	88	1	125	0	21	0
19, . .	-	240	10	97	4	32	0	185	0	-	-	85	0
20, . .	1,050	160	0	80	0	23	11	110	0	-	-	-	-
21, . .	560	163	10	-	-	87	2	62	0	-	-	-	-
22, . .	490	186	0	52	0	48	16	-	-	61	0	-	-
23, . .	448	-	0	53	0	84	14	136	8	29	0	121	0
24, . .	780	82	0	42	0	260	0	90	0	-	-	-	-
25, . .	203	38	0	47	0	-	-	-	-	162	3	-	-
26, . .	-	90	0	78	0	35	35	184	0	-	-	-	-
27, . .	120	59	0	45	0	-	-	60	11	-	-	-	-
28, . .	125	60	0	-	-	38	5	50	0	127	0	-	-
29, . .	102	73	0	52	0	60	0	-	-	-	-	-	-
30, . .	80	-	-	51	0	27	5	-	-	58	0	-	-
31, . .	55	-	-	39	0	15	0	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 49.

[Parts per 100,000.]

1895.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen	Bacteria per Cubic Centimeter.
May, . . .	9,980,000	61	55	.30	.0002	.0078	.20	.0480	.0000	.26	88	780
June, . .	9,380,000	71	67	.25	.0004	.0081	.24	.0340	.0000	.28	44	148
July, . .	9,260,000	72	70	.31	.0000	.0099	.26	.0310	.0000	.31	19	60
August, . .	9,260,000	73	74	.22	.0004	.0095	.30	.0350	.0003	.26	05	33
September, .	9,080,000	71	70	.19	.0013	.0096	.30	.0350	.0002	.20	00	60
October, . .	9,540,000	51	54	.51	.0013	.0144	.24	.0260	.0000	.52	20	61
November, .	7,280,000	44	44	.55	.0032	.0162	.22	.0210	.0000	.60	100	21

Filter No. 50.

This continuous filter was started July 23, 1894, and contained 60 inches in depth of sand of an effective size of 0.48 millimeter. The history of the filter up to Dec. 31, 1894, has been published in previous reports of the Board. Its history during 1895 contains the following principal points: —

From Dec. 1, 1894, to April 30, 1895, the filter was not in operation. On May 1, 1895, with a depth of 58 inches, after having been filled slowly from below with city water, this filter began to filter canal water continuously at a prescribed rate of 5,000,000 gallons per acre daily. A trap attached to the outlet of the filter prevented air from entering at that point. Owing to a stoppage in the feed-pipe on May 25, the surface of the sand became uncovered, and the filter was not in operation for twenty-six hours. On account of low water in the canal the gate on the outlet was closed, though the surface remained covered with water, on the following dates: June 8, July 6, 13, August 3, September 22 and 28, for periods varying from twenty-four to thirty-nine hours. In order to remove clogging the surface of the sand was scraped as follows: on June 18, 0.41 inch of sand was removed; on July 18, 0.47 inch; July 27, 0.47 inch; August 21, 0.63 inch; on August 31 enough sand was removed to reduce the depth of filtering material to 36 inches; October 15, 0.42 inch; November 7, 0.70 inch. After scraping, the filter was not raked, and canal water was applied above, except on October 15, when the filter was filled slowly with city water from

below. On October 7 the rate of filtration was fluctuated by closing the gate on the outlet for one minute and then opening the gate abruptly to the usual point. A record of the daily (excepting Sundays and on certain other occasions) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 50, 1895.

Day.	May.	June.	July.	August.	September.	October.	November.
1,	350	71	35	37	-	30	21
2,	1,190	-	37	28	-	-	-
3,	434	85	16	30	110	2,646	-
4,	310	24	-	-	98	-	16
5,	-	64	31	50	162	144	-
6,	455	45	50	39	58	-	23
7,	210	50	-	55	-	76	-
8,	108	45	52	30	-	123	63
9,	52	-	54	27	32	-	-
10,	146	70	109	34	54	-	-
11,	135	53	87	-	56	-	27
12,	-	34	97	50	47	350	-
13,	91	88	151	75	-	-	31
14,	72	62	-	31	6	116	-
15,	76	62	130	35	-	420	14
16,	56	-	102	29	9	-	-
17,	74	42	97	18	20	160	-
18,	43	46	90	-	31	135	48
19,	-	430	85	67	90	-	60
20,	110	84	53	32	75	-	-
21,	30	78	-	31	42	-	-
22,	70	73	21	27	-	71	-
23,	93	-	57	50	170	52	112
24,	72	85	35	38	41	-	-
25,	97	37	52	-	-	130	-
26,	-	106	14	15	57	-	-
27,	122	174	24	-	-	-	-
28,	55	85	-	60	52	35	-
29,	40	70	30	37	-	-	-
30,	56	-	42	18	-	45	-
31,	47	-	52	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 50.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
May, . . .	4,580,000	61	63	.40	.0004	.0098	.17	.0230	.0000	.35	57	141
June, . .	4,740,000	71	70	.30	.0006	.0089	.21	.0260	.0000	.33	32	64
July, . .	4,760,000	72	70	.27	.0005	.0095	.26	.0330	.0000	.29	30	82
August, . .	4,860,000	73	72	.22	.0023	.0090	.30	.0330	.0002	.26	4	34
September, .	4,660,000	71	71	.18	.0008	.0088	.29	.0320	.0000	.18	14	44
October, . .	5,000,000	51	53	.48	.0009	.0126	.23	.0250	.0000	.53	23	51
November, .	4,900,000	44	44	.59	.0015	.0151	.20	.0180	.0000	.58	102	42

Filter No. 62.

This continuous filter was started Sept. 2, 1895, and contained 48 inches in depth of sand of an effective size of 0.40 millimeter. The history of this filter during 1895 contains the following principal points: —

The sand for this filter was obtained from the beach at Plum Island on the sea coast 20 miles from Lawrence. Canal water was applied slowly from above until it covered the surface of the sand. The filter then stood full of water for forty-eight hours, and started, on September 2, to filter canal water continuously at a prescribed rate of 5,000,000 gallons per acre daily. A trap attached to the outlet prevented air from entering at this point. Owing to low water in the canal the gate on the outlet remained closed and the surface of the sand covered with water on September 22 and 28 for twenty-four and thirty-three hours, respectively. In order to remove clogging the surface of the sand was scraped as follows: on October 2, 0.30 inch of sand was removed; October 24, 0.50 inch; November 9, 0.47 inch; and on November 19, 0.41 inch. After scraping, the surface was not raked. On October 2 and 24 the filter was filled slowly from below with city water, but on November 9 and 19 canal water was applied above, immediately after scraping.

On September 19 the rate was fluctuated by closing the valve on the outlet for one minute and then opening the valve suddenly to the usual point. On October 19 the rate was fluctuated by throw-

ing the valve wide open for a minute and then closing it to the usual point.

A solution seeded with *B. prodigiosus* was mixed with the applied canal water in the ratio of 1 part to 170,000, for ten hours daily, from September 26 to November 23.

When the filter went out of operation on Nov. 23, 1895, the valve was thrown wide open and the sand allowed to drain.

A record of the daily (excepting Sundays and on some other occasions) bacterial analyses will be found in the following table : —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 62, 1895.

Day.	September.		October.		November.	
	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1,	-	-	67	2	25	3
2,	-	-	-	-	-	-
3,	-	-	5,530	4	-	-
4,	-	-	-	-	145	0
5,	-	-	266	2	-	-
6,	230	-	-	-	45	0
7,	-	-	160	1	-	-
8,	-	-	223	0	57	0
9,	120	-	-	-	-	-
10,	69	-	-	-	-	-
11,	65	-	-	-	29	0
12,	94	-	1,260	16	-	-
13,	-	-	-	-	21	0
14,	-	-	190	0	-	-
15,	-	-	144	4	28	0
16,	48	-	-	-	-	-
17,	64	-	132	0	-	-
18,	180	-	97	7	30	0
19,	420	-	-	-	67	0
20,	87	-	-	-	-	-
21,	280	-	-	-	-	-
22,	-	-	116	1	-	-
23,	1,078	-	60	1	135	0
24,	81	-	116	27	-	-
25,	-	-	196	3	-	-
26,	156	0	-	-	-	-
27,	-	-	-	-	-	-
28,	102	12	78	2	-	-
29,	-	-	-	-	-	-
30,	-	-	32	1	-	-
31,	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 62.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature, Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
September, .	4,720,000	71	71	.20	.0070	.0131	.29	.0250	.0001	.23	-	135
October, . .	4,900,000	51	53	.48	.0015	.0150	.23	.0250	.0000	.54	29	142
November, .	4,720,000	44	45	.59	.0021	.0157	.20	.0210	.0000	.58	98	56

Filter No. 63.

This continuous filter was started Sept. 2, 1895, and contained 24 inches in depth of sand of an effective size of 0.16 millimeter. The history of its construction and operation during 1895 is as follows: —

After removing the sand from Filter No. 38, without disturbing the under-drains, 2 feet of Berkshire sand — a white, sharp, pure quartz sand, such as is used in the manufacture of glass — was put into the filter dry. Canal water was then applied from above until the surface of the sand was covered. Having stood full of water for forty-six hours the filter began, on September 2, to filter canal water continuously at a prescribed rate of 5,000,000 gallons per acre daily. A trap attached to the outlet prevented air from entering at that point. Owing to low water in the canal the gate on the outlet remained closed, and the surface of the sand covered with water on September 22 and 28, for periods varying from twenty-four to thirty-three hours. On September 21 the filter drained until the surface of the sand almost became uncovered. In order to remove clogging the surface of the sand was scraped as follows: on September 12, 0.39 inch of sand was removed; on September 19, 0.32 inch; October 2, 0.28 inch; October 9, 0.26 inch; October 16, 0.36 inch; October 19, 0.34 inch; October 28, 0.33 inch; November 2, 0.28 inch; November 7, 0.40 inch; November 16, 0.49 inch; November 19, 0.34 inch. After scraping, the filter was not raked, and canal water was applied above immediately, except on October 9, when the filter was filled slowly from below with city water. On November 9 the rate was fluctuated by opening the faucet for one minute, so that the normal rate was doubled.

A solution seeded with *B. prodigiosus* was mixed with the applied canal water in the proportion of 1 part to 170,000, for 10 hours a day (excepting Sundays and on some other occasions), from September 26 to November 23. On the latter date the filter went out of operation for the year. It was allowed to drain and the outlet remained open during the winter.

A record of the daily (excepting on Sundays and on certain other occasions) bacterial analyses will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 63, 1895.

Day.	September.		October.		November.	
	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.	Water Bacteria.	B. Prodigiosus.
1,	-	-	85	6	46	0
2,	-	-	-	-	60	0
3,	-	-	10,028	8	-	-
4,	910	-	-	-	28	0
5,	2,870	-	238	0	-	-
6,	625	-	-	-	24	0
7,	-	-	190	0	-	-
8,	-	-	122	2	42	0
9,	80	-	-	-	-	-
10,	75	-	98	0	-	-
11,	58	-	3,570	0	35	0
12,	90	-	415	0	-	-
13,	-	-	-	-	27	0
14,	-	-	420	2	-	-
15,	-	-	122	7	39	0
16,	42	-	-	-	-	-
17,	23	-	101	0	-	-
18,	280	-	132	3	61	0
19,	2,742	-	-	-	50	0
20,	441	-	-	-	-	-
21,	3,427	-	-	-	-	-
22,	-	-	65	0	-	-
23,	420	-	37	0	65	0
24,	210	-	-	-	-	-
25,	-	-	70	0	-	-
26,	160	1	-	-	-	-
27,	-	-	-	-	-	-
28,	78	0	42	3	-	-
29,	-	-	-	-	-	-
30,	-	-	30	0	-	-
31,	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 63.

[Parts per 100,000.]

1895.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature, Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
September,	4,500,000	71	71	.24	.0039	.0123	.29	.0260	.0003	.25	-	237
October,	4,740,000	51	49	.49	.0019	.0146	.23	.0260	.0002	.57	27	78
November,	4,720,000	44	47	.59	.0019	.0147	.20	.0240	.0000	.59	98	37

Filter No. 64.

This continuous filter was started Sept. 2, 1895, and contained 12 inches in depth of sand of an effective size of 0.16 millimeter. The method of construction and the history of this filter during 1895 is as follows: —

After removing the sand from Filter No. 46, without disturbing the under-drains, 1 foot of Berkshire sand — similar to that already described under Filter No. 63 — was put into the filter dry. Canal water was then applied from above until the surface of the sand was covered. Having stood full of water for forty-six hours, the filter began to filter canal water continuously, on September 2, at a prescribed rate of 5,000,000 gallons per acre daily. A trap attached to the outlet prevented air from entering at that point. Owing to low water in the canal the filter remained closed and the surface of the sand covered with water, on the following dates: September 22 for twenty-four hours and September 28 for thirty-three hours. In order to remove clogging the surface of the sand was scraped as follows: on September 10, 0.26 inch of sand was removed; September 16, 0.30 inch; September 21, 0.28 inch; September 28, 0.35 inch; October 5, 0.27 inch; October 11, 0.26 inch; October 26, 0.32 inch; October 17, 0.42 inch; October 21, 0.28 inch; October 26, 0.26 inch; November 1, 0.34 inch; November 5, 0.31 inch; November 9, 0.35 inch; November 15, 0.34 inch; and November 19, 0.34 inch. After scraping, the surface was not raked but canal water applied from above immediately.

On October 29 the rate was fluctuated by increasing it for one minute from 5,000,000 to 7,500,000 gallons per acre daily. On November 23 the filter was shut off for the winter, and the gate on the outlet left open to allow the filter to drain.

A solution seeded with *Bacillus prodigiosus* was mixed with the applied canal water in the ratio of 1 part to 170,000 parts, for ten hours a day (excepting Sundays and on some other occasions), from September 26 to November 23.

A record of the daily bacterial analyses (excepting on Sundays and on certain other days) will be found in the following table: —

Average Daily Number of Bacteria per Cubic Centimeter in Effluent of Filter No. 64, 1895.

Day.	September. Water Bacteria.	September. B. Prodigiosus.	October. Water Bacteria.	October. B. Prodigiosus.	November. Water Bacteria.	November. B. Prodigiosus.
1,	-	-	110	18	-	-
2,	-	-	-	-	-	-
3,	-	-	6,969	3	-	-
4,	1,190	-	-	-	34	0
5,	4,634	-	347	4	-	-
6,	266	-	-	-	31	0
7,	-	-	130	2	-	-
8,	-	-	118	0	47	0
9,	70	-	-	-	-	-
10,	40	-	2,760	12	-	-
11,	71	-	-	-	44	4
12,	97	-	714	4	-	-
13,	-	-	-	-	25	0
14,	-	-	182	0	-	-
15,	-	-	135	4	152	2
16,	60	-	-	-	-	-
17,	22	-	280	0	-	-
18,	791	-	170	2	108	-
19,	450	-	-	-	65	11
20,	195	-	-	-	-	-
21,	540	-	-	-	-	-
22,	-	-	41	0	-	-
23,	420	-	30	0	122	4
24,	116	-	-	-	-	-
25,	-	-	44	5	-	-
26,	190	4	-	-	-	-
27,	-	-	-	-	-	-
28,	110	8	41	0	-	-
29,	-	-	-	-	-	-
30,	-	-	28	0	-	-
31,	-	-	-	-	-	-

Monthly Averages of Analyses of Effluent of Filter No. 64.

[Parts per 100,000.]

1895.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
September,	4,480,000	71	71	.25	.0032	.0123	.29	.0250	.0003	.26	-	128
October,	4,680,000	51	53	.51	.0009	.0146	.23	.0240	.0000	.57	82	74
November,	4,520,000	44	46	.59	.0030	.0155	.20	.0230	.0000	.60	103	48

Lawrence City Filter.

The filter of the water supply system of the city of Lawrence is 2.5 acres in area, was first put in operation Sept. 20, 1893, and its construction and action was described in the report of the State Board of Health for that year. From the date of starting this filter up to the present time it has been in continuous use, and not once has the unfiltered river water entered the reservoir or the service pipes of the city water supply.

The average bacterial efficiency of the filter for the entire year has always been about 99 per cent., but varies with different seasons, being considerably greater in summer than in winter. The most important reason for the lower bacterial efficiency in winter is that, contrary to the advice of the designer, the filter remains uncovered and unprotected from the severe cold of the winters of the climate of Lawrence. In consequence of this a thick coating of ice forms upon the filter, and, to enable the surface of the filter to be cleaned of clogged and dirty sand, and thus kept in operation, this layer of ice, sometimes approximating 2 feet in thickness, has to be removed. Its removal is slowly accomplished by the city laborers and the surface of the filter very much disturbed during the process. With the force employed the removal of the main body of the ice is so slowly accomplished that in order to get a sufficient daily volume of water through the filter, it is necessary to frequently stop removing the thick ice and remove the newly formed ice and scrape the beds just previously scraped. With these conditions abnormal and unnecessary results are obtained. That is to say, as a result of this management, a small portion of the filter is, for weeks at a time, filtering a very large proportion of the water pumped. The surface of the filter is divided by drains and elevations of its surface into thirty-three sections or beds, and between December 11 and April 10 the first two beds (beginning at the end of the filter nearest the pumping house) were scraped and raked eight times, the next eighteen beds five and one-half times and the remaining thirteen beds two and one-half times, and these last were not scraped at all during January and February.

This method of operation is unfavorable to obtaining efficient filtration, and if the filter remains uncovered it will be necessary to remove the ice with sufficient rapidity to clean all of the beds monthly and to avoid repeated scraping of the same beds and the

consequent filtration of a large part of the water through a small area of the filter at a very high rate.

An experiment to illustrate the effect of this treatment upon bacterial efficiency was made with Filter No. 3 B at the station. About one-quarter of the surface of this filter was scraped and then disturbed to the depth of several inches and the filter started at its rate of filtration of 5,000,000 gallons per acre daily. The average number of bacteria per cubic centimeter in the effluent of this filter before this treatment was 7 per cubic centimeter; following the treatment the number quickly increased to a maximum of 1,897 per cubic centimeter and not for several days did the bacterial efficiency of the filter return to the normal. This is parallel to the treatment of the Lawrence city filter in the winter months, which results in giving at times the high numbers of bacteria in its effluent presented in the tables on page 573, and those in charge have been repeatedly advised against this unfavorable method of operation.

Beginning Nov. 15, 1895, a daily bacterial analysis was made of the river water before and after its passage through the filter, and as it flowed from taps at the city hall and experiment station. This daily bacterial examination was continued until May, and the results are presented beyond. The hygienic efficiency of the filter is shown by a table on page 7.

During the winter months the filter is at times operated continuously.

Cost of Operation of the Filter.

During 1895, 1,096,000,000 gallons of water passed through the city filter, and upon page 7 of the report of the Lawrence water board for the year 1895 it is stated that the cost of maintenance of the filter for the year was $11,038. Exclusive of amounts not properly chargeable to filter maintenance, such as grading, paving, care of lawns and improvements about the pumping station and filter beds, the total expense for maintenance was $7,400, or $6.75 per million gallons of water filtered. The itemized figures for the year kindly furnished by Mr. Salisbury, the superintendent of the Lawrence water department, are as follows: for scraping the filter and replacing sand, $3,477; for removing ice, $2,903; for washing 1,500 cubic yards of sand, $1,020. For scraping and replacing sand only, the cost was $3.10 per million gallons filtered. All laborers upon this work are paid $2 per day.

Monthly Averages of Analyses of the Merrimack River Water as it flows upon the Lawrence City Filter.

[Parts per 100,000.]

1895.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Bacteria per Cubic Centimeter.
January,	32	.36	.0119	.0203	.0168	.29	.0200	.0002	.41	1.9	20,000
February,	32	.38	.0132	.0217	.0173	.31	.0190	.0002	.43	2.0	15,000
March,	32	.43	.0079	.0202	.0159	.23	.0220	.0001	.48	1.4	17,000
April,	45	.44	.0027	.0157	.0134	.17	.0140	.0000	.48	1.3	9,000
May,	62	.46	.0061	.0178	.0153	.16	.0110	.0001	.46	1.0	7,000
June,	72	.48	.0099	.0223	.0164	.20	.0090	.0001	.32	1.6	9,000
July,	75	.43	.0134	.0243	.0178	.27	.0110	.0003	.38	1.8	10,000
August,	73	.39	.0168	.0225	.0177	.30	.0100	.0004	.36	1.9	5,000
September,	68	.35	.0157	.0198	.0163	.29	.0080	.0004	.30	2.0	5,000
October,	53	.55	.0098	.0235	.0213	.24	.0120	.0003	.52	1.9	19,000
November,	45	.65	.0041	.0196	.0174	.20	.0140	.0000	.61	1.6	7,000
December,	35	.54	.0047	.0147	.0134	.18	.0150	.0001	.48	1.5	5,000

Monthly Averages of Effluent from the City Filter.

[Parts per 100,000.]

1895.	Temperature. Deg F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Bacteria per Cubic Centimeter
January,	35	.31	.0123	.0089	.0074	.31	.0300	.0001	.28	2.5	368
February,	34	.36	.0117	.0115	.0096	.32	.0350	.0001	.31	2.5	357
March,	35	.34	.0102	.0104	.0097	.29	.0350	.0000	.36	2.0	200
April,	43	.42	.0130	.0092	.0079	.19	.0360	.0001	.34	2.3	67
May,	62	.37	.0067	.0093	.0082	.17	.0390	.0000	.32	1.7	68
June,	72	.37	.0062	.0090	.0083	.24	.0410	.0001	.30	2.2	68
July,	73	.33	.0075	.0097	.0083	.39	.0450	.0001	.23	2.4	50
August,	74	.36	.0080	.0082	.0073	.33	.0370	.0001	.22	2.7	38
September,	69	.29	.0048	.0087	.0066	.31	.0360	.0002	.21	2.4	40
October,	55	.42	.0079	.0099	.0093	.38	.0360	.0003	.32	2.3	60
November,	45	.60	.0137	.0128	.0113	.24	.0350	.0000	.42	2.8	52
December,	38	.54	.0118	.0088	.0086	.21	.0450	.0001	.34	2.6	93

Monthly Averages of Analyses of Water from the Outlet of the Distributing Reservoir.

[Parts per 100,000.]

1895.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Bacteria per Cubic Centimeter.
January,	35	.31	.0092	.0094	.0082	.31	.0340	.0000	.28	2.5	121
February,	34	.33	.0100	.0090	.0085	.32	.0410	.0000	.29	2.5	143
March,	35	.35	.0116	.0106	.0093	.33	.0470	.0000	.30	2.5	282
April,	40	.37	.0075	.0110	.0085	.22	.0470	.0000	.33	2.2	105
May,	59	.33	.0022	.0099	.0086	.19	.0450	.0000	.29	1.7	367
June,	66	.31	.0033	.0089	.0079	.24	.0410	.0001	.27	2.2	112
July,	71	.27	.0022	.0099	.0081	.28	.0450	.0001	.21	2.4	69
August,	73	.25	.0020	.0085	.0073	.32	.0380	.0003	.20	2.4	51
September,	68	.20	.0025	.0076	.0065	.31	.0390	.0003	.18	2.4	75
October,	56	.24	.0020	.0077	.0072	.29	.0420	.0001	.17	2.4	36
November,	46	.54	.0060	.0134	.0117	.25	.0350	.0000	.39	2.3	36
December,	38	.53	.0062	.0101	.0097	.21	.0330	.0000	.37	2.2	62

Monthly Averages of Analyses of Water from a Tap at the Lawrence City Hall.

[Parts per 100,000.]

1895.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Bacteria per Cubic Centimeter.
January,	37	.31	.0071	.0085	.31	.0340	.0001	.28	2.4	149
February,	36	.33	.0082	.0088	.32	.0410	.0001	.28	2.4	104
March,	39	.32	.0096	.0086	.35	.0480	.0000	.29	2.6	104
April,	41	.36	.0064	.0094	.22	.0460	.0000	.31	2.3	92
May,	57	.32	.0010	.0089	.20	.0470	.0000	.26	1.7	171
June,	64	.29	.0009	.0081	.24	.0420	.0000	.26	2.2	64
July,	69	.24	.0015	.0081	.29	.0430	.0000	.19	2.3	56
August,	70	.25	.0011	.0078	.31	.0390	.0000	.18	2.4	55
September,	65	.21	.0012	.0071	.31	.0390	.0000	.17	2.4	50
October,	57	.22	.0015	.0075	.29	.0400	.0000	.16	2.4	51
November,	47	.52	.0043	.0118	.25	.0350	.0000	.38	2.5	50
December,	41	.51	.0050	.0091	.21	.0360	.0001	.37	2.1	62

Monthly Averages of Analyses of Water from a Tap at the Lawrenee Experiment Station.

[Parts per 100,000.]

1895.	Temperature — Deg. F.	Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Hardness.	Bacteria per Cubic Centimeter.
			Free.	Albuminoid		Nitrates.	Nitrites.				
January, . .	39	.32	.0048	.0081	.31	.0350	.0003	.26	100	2.5	125
February, . .	38	.33	.0059	.0079	.32	.0430	.0000	.27	89	2.6	107
March, . . .	40	.32	.0085	.0089	.35	.0470	.0000	.28	81	2.6	110
April, . . .	41	.35	.0045	.0092	.22	.0430	.0000	.31	81	2.2	85
May, . . .	53	.30	.0008	.0085	.20	.0450	.0000	.26	67	1.7	108
June, . . .	60	.27	.0003	.0072	.27	.0460	.0000	.24	55	2.2	75
July, . . .	66	.21	.0003	.0078	.29	.0420	.0000	.18	58	2.2	85
August, . . .	70	.17	.0003	.0066	.32	.0390	.0000	.17	51	2.4	48
September, . .	67	.17	.0002	.0052	.31	.0380	.0000	.15	51	2.4	53
October, . . .	58	.19	.0001	.0053	.27	.0410	.0000	.15	78	2.3	40
November, . .	48	.50	.0013	.0116	.25	.0350	.0000	.38	100	2.2	47
December, . .	45	.49	.0021	.0093	.21	.0360	.0000	.38	95	2.2	47

Daily Bacterial Results, Lawrenee City Water.

[Bacteria per Cubic Centimeter.]

Date — 1895.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head. — Feet.
		City Filter.	Reservoir Outlet.	Tap at City Hall.	Tap at Experiment Station.		
November 11, . .	5,800	40	19	41	32	Drained.	7.3
12, . .	6,400	55	37	19	27	Drained.	7.3
13, . .	4,100	62	40	37	40	Drained.	5.6
14, . .	6,200	42	26	31	26	Drained.	5.3
15, . .	11,500	57	49	36	38	Covered.	5.8
16, . .	11,200	65	51	49	52	Covered.	6.5
17, . .	-	-	-	-	-	-	-
18, . .	11,000	74	52	61	64	Covered.	4.6
19, . .	10,500	76	108	62	60	Covered.	5.6
20, . .	8,700	75	45	42	60	Covered.	6.4
21, . .	14,000	34	40	58	51	Drained.	6.1
22, . .	10,900	120	58	60	69	Covered.	5.1
23, . .	13,000	120	95	74	81	Covered.	5.1
24, . .	-	-	-	-	-	-	-
25, . .	6,200	70	58	51	49	Covered.	5.2
26, . .	5,800	50	65	57	57	Drained.	5.3
27, . .	5,800	49	70	63	75	Drained.	5.7
28, . .	-	-	-	-	-	Drained.	5.1
29, . .	5,800	18	49	42	36	Drained.	5.4
30, . .	10,500	78	89	74	65	Drained.	5.6

Daily Bacterial Results, Lawrence City Water — Continued.

[Bacteria per Cubic Centimeter.]

Date — 1895.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head.
		City Filter.	Reservoir Outlet.	Tap at City Hall.	Tap at Experiment Station.		Feet.
December 1, . . .	-	-	-	-	-	Drained.	-
2, . . .	5,500	61	67	68	88	Covered.	4.8
3, . . .	4,000	35	51	66	41	Drained.	5.1
4, . . .	4,300	67	50	44	62	Covered.	4.9
5, . . .	4,900	49	65	55	42	Covered.	4.9
6, . . .	11,000	38	43	53	55	Drained.	5.3
7, . . .	4,500	87	63	69	43	Covered.	5.6
8, . . .	-	-	-	-	-	-	-
9, . . .	3,100	51	50	47	37	Covered.	4.8
10, . . .	3,400	50	41	38	47	Covered.	5.1
11, . . .	4,300	55	64	60	46	Drained.	5.5
12, . . .	3,400	64	35	39	36	Covered.	5.4
13, . . .	3,500	112	71	37	49	Covered.	5.3
14, . . .	6,100	210	64	51	51	Covered.	-
15, . . .	7,200	180	79	61	47	-	4.6
16, . . .	4,500	118	56	41	56	Covered.	4.6
17, . . .	-	-	-	-	-	Covered.	4.4
18, . . .	6,700	92	62	53	47	Covered.	5.3
19, . . .	11,200	130	40	50	58	Drained.	5.8
20, . . .	6,100	41	51	42	34	Drained.	5.8
21, . . .	5,000	66	49	48	48	Covered	5.8
22, . . .	-	-	-	-	-	-	-
23, . . .	7,800	105	67	74	-	Covered.	5.2
24, . . .	16,000	124	84	70	67	Covered.	5.5
25, . . .	-	-	-	-	-	-	-
26, . . .	7,500	109	85	80	104	Covered	5.3
27, . . .	11,200	52	145	68	52	Drained.	6.5
28, . . .	11,500	76	82	72	95	Drained.	6.5
29, . . .	-	-	-	-	-	Covered.	5.9
30, . . .	-	-	-	77	76	Drained.	5.8
31, . . .	8,300	55	78	80	68	Drained.	6.1

Daily Bacterial Results, Lawrence City Water — Continued.

[Bacteria per Cubic Centimeter.]

Date — 1896.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head.
		City Filter.	Reservoir Outlet.	Tap at City Hall.	Tap at Experiment Station.		Feet.
January 1,	7,000	85	101	82	80	Drained.	5.8
2,	5,000	67	75	57	53	Drained.	5.3
3,	6,700	74	132	68	59	Drained.	6.3
4,	5,400	93	64	46	-	Drained.	6.5
5,	-	-	-	-	-	Drained.	-
6,	4,800	47	112	62	49	Covered.	5.4
7,	5,500	79	120	74	68	Covered.	5.7
8,	4,100	126	92	85	70	Covered	5.7
9,	18,200	233	112	78	63	Covered.	5.3
10,	5,500	433	93	75	72	Covered.	5.0
11,	7,000	567	205	125	88	Covered.	4.7
12,	-	-	-	-	-	Covered.	-
13,	10,200	588	170	113	72	Covered.	4.3
14,	5,000	213	135	120	84	Covered.	4.5
15,	15,000	410	175	118	107	Covered.	4.6
16,	10,200	389	240	170	116	Covered.	4.5
17,	10,900	231	223	151	106	Covered.	4.5
18,	13,000	198	231	115	111	Covered.	4.9
19,	-	-	-	-	-	Covered.	-
20,	12,000	130	170	125	101	Covered.	4.9
21,	8,200	57	162	144	105	Covered.	6.2
22,	6,500	62	162	93	89	Drained.	7.4
23,	3,500	52	61	52	36	Covered.	6.5
24,	7,200	52	116	57	60	Covered.	6.1
25,	4,500	52	65	62	65	Covered.	6.6
26,	-	-	-	-	-	Covered.	-
27,	8,100	71	117	74	69	Covered.	6.3
28,	4,800	25	49	40	34	Covered.	7.6
29,	4,100	59	65	78	69	Covered.	7.9
30,	4,100	53	62	62	49	Covered.	8.5
31,	7,200	36	64	61	61	Drained.	7.5

Daily Bacterial Results, Lawrence City Water — Continued.

[Bacteria per Cubic Centimeter.]

Date — 1896.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head.
		City Filter.	Reservoir Outlet.	Tap at City Hall.	Tap at Experiment Station.		Feet.
February 1, . . .	6,700	93	64	55	48	Covered.	5.3
2, . . .	-	-	-	-	-	-	-
3, . . .	3,400	75	47	27	31	Covered.	5.0
4, . . .	4,200	136	70	61	-	Covered.	5.6
5, . . .	6,000	63	-	58	49	Drained.	6.4
6, . . .	9,500	322	-	-	69	Covered.	5.8
7, . . .	21,400	580	169	61	74	Covered.	5.9
8, . . .	35,000	567	263	216	95	Drained.	6.5
9, . . .	-	-	-	-	-	-	-
10, . . .	21,000	385	356	212	202	Covered.	5.6
11, . . .	14,000	567	243	210	196	Covered.	7.0
12, . . .	13,000	108	180	247	162	Drained.	7.2
13, . . .	14,000	330	250	250	203	Drained.	7.2
14, . . .	11,000	131	254	184	139	Drained.	7.4
15, . . .	7,700	316	128	175	120	Covered.	6.5
16, . . .	-	-	-	-	-	-	-
17, . . .	11,000	425	261	223	200	Covered.	5.1
18, . . .	9,900	356	250	232	204	Covered.	5.0
19, . . .	12,000	521	310	209	192	Covered.	5.0
20, . . .	14,000	346	370	220	160	Covered.	4.9
21, . . .	12,000	327	223	143	118	Covered.	5.0
22, . . .	15,000	162	111	235	168	Drained.	5.7
23, . . .	-	-	-	-	-	-	-
24, . . .	10,000	198	205	185	182	Covered.	5.0
25, . . .	15,000	360	174	132	157	Covered.	5.1
26, . . .	12,000	554	770	150	175	Drained.	5.6
27, . . .	-	-	-	-	-	Covered.	5.7
28, . . .	-	-	-	-	-	Drained.	5.9
29, . . .	-	-	-	-	-	Covered.	5.7

Daily Bacterial Results, Lawrence City Water — Continued.

[Bacteria per Cubic Centimeter.]

Date — 1896.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head.
		City Filter.	Reservoir Outlet.	Tap at City Hall	Tap at Experiment Station.		Feet.
March 1, ...	-	-	-	-	-	Drained.	-
2, ...	-	-	-	-	-	Drained.	4.3
3, ...	-	-	-	-	-	Drained.	5.0
4, ...	-	-	-	-	-	Covered.	5.9
5, ...	-	-	-	-	-	Covered.	5.4
6, ...	-	-	-	-	-	Covered.	6.6
7, ...	-	72	65	85	-	Covered.	7.8
8, ...	5,200	97	-	-	-	-	-
9, ...	5,200	97	160	170	107	Drained.	6.8
10, ...	6,500	84	101	110	94	Covered.	7.9
11, ...	11,400	93	128	97	98	Covered.	8.0
12, ...	8,800	110	85	137	94	Covered.	7.9
13, ...	6,700	139	118	50	98	Drained.	7.9
14, ...	5,400	166	64	85	175	Drained.	7.8
15, ...	-	-	-	-	-	-	-
16, ...	8,300	358	107	98	-	Drained.	7.8
17, ...	6,100	234	108	116	118	Drained.	8.0
18, ...	5,500	127	90	70	143	Drained.	7.8
19, ...	3,200	-	114	124	172	Covered.	7.8
20, ...	9,200	88	149	142	174	Drained.	7.7
21, ...	7,100	63	85	93	132	Covered.	8.0
22, ...	-	-	-	-	-	-	-
23, ...	4,200	314	70	85	165	Drained.	6.0
24, ...	3,000	44	96	77	102	Covered.	7.8
25, ...	3,000	41	78	69	250	Drained.	7.8
26, ...	1,200	36	77	66	95	Drained.	7.9
27, ...	-	-	53	51	87	Covered.	8.0
28, ...	-	-	-	-	128	Drained.	5.3
29, ...	-	-	-	-	-	Drained.	5.8
30, ...	7,000	255	80	99	93	Drained.	6.3
31, ...	4,300	99	292	98	101	Covered.	6.8

Daily Bacterial Results, Lawrence City Water — Concluded.

[Bacteria per Cubic Centimeter.]

Date — 1896.	In River Water.	In Filtered Water from				Condition of Surface when Pumps were Stopped.	Loss of Head.
		City Filter.	Reservoir Outlet.	Tap at City Hall.	Tap at Experiment Station.		Feet.
April 1,	7,600	50	114	84	122	Drained.	6.5
2,	6,100	56	1,253	40	145	Covered.	6.8
3,	3,300	56	326	214	85	Covered.	7.0
4,	2,800	98	256	119	118	Covered.	5.7
5,	-	-	-	-	-	Covered.	-
6,	2,800	63	114	109	88	Covered.	4.9
7,	3,200	44	47	86	66	Covered.	5.3
8,	2,300	51	109	47	80	Drained.	6.5
9,	1,800	27	60	77	122	Drained.	3.6
10,	8,600	30	102	57	104	Drained.	6.4
11,	4,900	38	92	58	68	Covered.	5.8
12,	-	-	-	-	-	-	-
13,	1,700	40	33	58	30	Covered.	5.2
14,	6,200	44	46	46	59	Drained.	5.9
15,	4,600	63	52	47	35	Drained.	6.6
16,	5,800	32	55	45	42	Drained.	6.5
17,	5,700	24	19	36	37	Covered.	5.7
18,	4,900	36	34	33	46	Covered.	5.7
19,	-	-	-	-	-	Covered.	4.9
20,	-	-	-	-	-	Covered.	-
21,	2,200	45	86	45	31	Covered.	4.3
22,	2,900	6	22	72	39	Covered.	5.2
23,	2,300	16	25	26	36	Drained.	6.2
24,	2,300	25	208	25	74	Drained.	6.3
25,	3,900	25	52	22	36	Covered.	5.6
26,	-	-	-	-	-	Covered.	-
27,	2,600	32	48	22	22	Covered.	4.9
28,	3,300	43	71	24	38	Drained.	6.3
29,	1,300	29	16	22	24	Drained.	7.0
30,	1,700	18	19	19	24	Drained.	6.2

Monthly Averages of Daily Bacterial Results from the Lawrence City Water.

Months.	Bacteria per Cubic Centimeter in Water from				
	River.	Effluent at Filter.	Reservoir Outlet.	City Hall Tap.	Experiment Station Tap.
1895.					
November,	8,700	64	56	50	52
December,	6,700	84	64	60	56
1896.					
January,	7,500	166	125	88	74
February,	12,600	315	235	166	140
March,	5,900	133	106	96	127
April,	3,800	40	130	57	63
Averages,	7,533	134	119	86	85
Per cent. which the average number of bacteria removed was of the average number of river bacteria,	-	98.22	98.42	98.86	98.87

It must be remembered that these results and the final averages are of the six months of the year when the bacterial efficiency of this uncovered filter is lowest.

METHODS EMPLOYED

AT THE

Lawrence Experiment Station

FOR THE

Quantitative Determination of Bacteria in Sewage and Waters.

By George W. Fuller and William R. Copeland.

METHODS EMPLOYED AT THE LAWRENCE EXPERIMENT STATION FOR THE QUANTITATIVE DETERMINATION OF BACTERIA IN SEWAGE AND WATERS.

By George W. Fuller and William R. Copeland.

In this paper it is proposed to record briefly the methods which have been employed recently in the determination of the number of bacteria in sewage and waters. It is also desired to point out certain modifications which have been made since the methods were originally described in the report of the State Board of Health upon the purification of sewage and water (1), and further, to present the evidence on which the more important changes were based.

The principal topics treated in this paper are noted in the following outline: —

1. Collection and storage of samples.
2. Preparation of culture media.
3. Sterilization and storage of culture media.
4. Technique of plating.
5. Technique of counting colonies of bacteria on plates.
6. Effect of length of period of cultivation and of temperature at which cultivation takes place.
7. Comparison of the relative values of gelatine and glycerine agar for quantitative bacterial work.
8. Roll cultures in four liter bottles.

Collection and Storage of Samples.

The samples of sewage, etc., for bacterial analysis are collected in mushroom ground-glass stoppered bottles of a capacity of about one ounce. Special care has been taken to procure a glass stopper with a mushroom top rising about half an inch from the top of the bottle. This form of stopper protects the mouth of the bottle from becoming contaminated by the fingers in removing the sterilized

bottle from its tin case. The bottles (especially new ones) are soaked for several hours in a solution of potassium permanganate and caustic soda. In fact, all glassware is treated with this solution before it is sterilized in order to remove all trace of organic matter; otherwise, organic matter contained in the bottle might serve as a food material for the bacteria present in the water to be analyzed and so allow them to multiply.

After treatment with permanganate, the bottles are rinsed in a dilute solution of sulphuric and oxalic acids. These acids remove the excess of permanganate and neutralize the free alkali. It is necessary to use much care in washing the bottles with water in order to remove all acid and to obtain as a result a sample bottle which is chemically clean. After cleaning and drying, the bottles, carefully stoppered, are placed in covered tin boxes made to fit the bottles approximately. The encased bottles and other glassware are then sterilized in an oven over a gas stove at a temperature of 160 degrees C. for an hour and a half.

When samples of sewage or water have been collected in such bottles they are placed in the ice compartment of a refrigerator, where, at a temperature of from 5 to 10 degrees C., they may be left for several hours without change. It should be noted here that samples collected out of town are not generally taken to the laboratory before plating, but are plated on the spot by the collector.

Preparation of Culture Media.

Until July, 1894, nutrient gelatine was employed as the regular culture medium for quantitative bacterial work. Since July, 1894, nutrient glycerine agar has been used instead of nutrient gelatine. In addition to gelatine and glycerine agar, a solution composed of one-tenth of one per cent. of peptone and two-tenths of one per cent. of powdered glucose in sterilized tap water has been used to obtain a pure culture of *Bacillus prodigiosus*. A measured quantity of this solution, seeded with this specific germ, has been applied from time to time to the several experimental water filters, as described on page 598.

The ingredients used have been of as high a grade as could be obtained from the best dealers. Meat infusions were made, prior to July, 1892, by allowing one pound of finely chopped lean meat to digest in one liter of cold water for about twenty hours. The

infusions were filtered while cold. This treatment removed almost all of the fat globules, while the filtrate contained the various other substances extracted from the meat. From July, 1892, to January, 1894, meat infusions were made by allowing one pound (about four hundred and fifty grams) of finely chopped lean meat to digest in one liter of warm tap water for two hours; they were then heated for thirty minutes in a bath of boiling water, boiled for ten minutes over a free flame, and filtered, while hot, to remove the particles of meat, fat and coagulated albumen. In January, 1894, it was decided to return to the original method of digesting the meat in cold water for the reasons which will appear beyond.

Until Dec. 15, 1894, Witte's peptone was used. Since Dec. 15, 1894, Merck's "Peptonum Siccum" has been used instead of Witte's. The leaf gelatine used is made by Comte Fils, and labelled "Best French Brand." Agar free from acid has been used, and the glycerine has been twice distilled. The powdered glucose used is a high-grade commercial product. Common table salt has been used in the proportion described in the original formula of Koch, apparently with the view to aid in dissolving ingredients of nutrient culture media.

Nutrient gelatine is prepared by adding to one liter of meat infusion one per cent. by weight of peptone, one-half of one per cent. of salt and ten per cent. of gelatine. After weighing the dish containing these substances it is placed in a bath of boiling water and stirred constantly for ten minutes. By this time the gelatine and peptone are dissolved, and, after replacing the water which has evaporated as shown by loss in weight, five cubic centimeters of the solution are placed in a porcelain evaporating dish containing fifty cubic centimeters of distilled water. It has been the custom to boil this solution for three minutes over a free flame in order to expel carbon dioxide and free ammonia which may have been present. These gases, otherwise, would interfere with the accuracy of the titration with phenolphthalein, which is used as an indicator in the determination of the acidity of the solution. After boiling for three minutes, one cubic centimeter of phenolphthalein (five grams of powder in one liter of fifty per cent. alcohol) is added, and while the solution is still hot, enough twentieth normal caustic soda added from a burette to produce a slight pink color. By this method it is possible to determine accurately the acidity of the solution (2).

Experience has shown that the acidity of gelatine solutions is so

great at this point that it is necessary to add from fifty-five to seventy cubic centimeters of normal caustic soda solution to one liter of gelatine in order to neutralize the acid present, when phenolphthalein is used as an indicator. It should be noted here that the scale adopted at the Lawrence Experiment Station is based on the number of cubic centimeters of normal caustic soda which must be added to one liter of solution to produce a neutral reaction with phenolphthalein.

The amount of acid found in the solution varies with the composition of the meat infusion, peptone and gelatine employed (2).

When the degree of acidity has been determined enough normal caustic soda is added to the solution to reduce the acidity of the entire volume to a point which is slightly alkaline to blue litmus paper if Schultz's method is to be employed in the preparation of gelatine, or slightly alkaline to phenolphthalein if Timpe's method is followed. These two methods of procedure are described beyond.

The advantage of allowing the meat to remain for twenty hours in water in an ice-chest, and of filtering the meat infusion while cold, now becomes apparent because the albumens left in the meat infusion serve as a coagulant in place of egg albumen, which, following the practice described in text books, is customarily added at this time to replace the albumens precipitated and removed from the solution by filtration if the infusion is extracted with boiling water.

When the alkali has been mixed thoroughly with the solution the dish is placed in a bath of boiling water for twenty minutes. After this the dish is removed from the water bath and set over a free flame for five minutes with constant stirring; by this treatment the solution is brought to a boil for two minutes, to aid in making it clear. After adding enough boiling water to replace the water which has evaporated, five cubic centimeters of the solution are again titrated as described above. The degree of reaction changes slightly during the process of heating. Owing to changes in some of the ingredients the solution becomes a little more acid (from three to five cubic centimeters of normal acid per one liter). The next step in the process is to filter the solution rapidly through coarse flannel and absorbent cotton. To the filtrate it is necessary to add enough normal acid or alkali to produce the required degree of reaction. The gelatine is then placed in sterilized test-tubes (five cubic centimeters in each tube) and the tubes plunged at once

into cold water until the gelatine has solidified. These tubes are then sterilized in an Arnold steam sterilizer for thirty minutes on each of three consecutive days, or in an autoclave at a pressure of one atmosphere for from five to seven minutes.

Nutrient agar is prepared by adding to one liter of meat infusion, peptone and salt as in the preparation of gelatine, and one and three-tenths per cent. by weight of finely chopped agar. The remaining steps in its preparation are similar to those already described for gelatine, except that it is the custom to boil agar slowly for one hour over a free flame. To assist the process of dissolving the agar, five hundred cubic centimeters of water are added to the original volume of one liter before heat is applied.

Agar itself has been found to be neutral to phenolphtalein, therefore, the reaction of the solution is much lower at this point than a solution of gelatine would have been. The total acidity of the solution at this point ranges from thirty-five to forty-five cubic centimeters of normal acid per liter.

After titration and addition of normal alkali the agar is placed over a free flame and boiled slowly for two hours. In order to keep conditions of temperature and volume as nearly constant as possible during this process, boiling water is added from time to time to replace the water which has evaporated. When the agar has been heated for two hours and has been restored to its original volume it is filtered and titrated. The reaction of the medium changes very little during this process of heating. To the filtrate six per cent. by weight of twice-distilled glycerine is added, the solution titrated and enough normal acid or alkali put in to produce the required reaction. The solution is then tubed and placed in cold water. As agar does not lose its power to solidify even though heated for a long period of time, it has been the custom to sterilize it in the Arnold steam sterilizer for one hour on each of three consecutive days. Since June, 1895, it has been the custom to sterilize it in an autoclave for fifteen minutes at a pressure of one atmosphere.

As noted above, both Witte's and Merck's peptones have been used in these investigations, and Merck's has been employed during the present year. Experiments have shown that the composition of peptones influences somewhat the bacterial results, as has been described in an article published elsewhere (2) (8).

The present supply of Merck's peptone is found to be very satisfactory.

Reference has already been made to Schultz's (3) and Timpe's methods of alkalization. Schultz's method affords a more accurate means than the method originally described by Koch of carrying out the general procedure, and has been followed almost from the outset in the preparation of nutrient culture media. In brief, this method consists of adding enough normal alkali to an acid solution of a nutrient medium to reduce the acidity before heating to the degree which it is desired to maintain in the nutrient medium for plating. Timpe's (4) method consists of adding enough normal alkali to reduce the acidity before heating to the neutral point (phenolphthalein being used as an indicator) and the addition after heating of enough normal acid or alkali to the filtrate to produce the desired degree of reaction.

Until the middle of the year 1891 the method ordinarily described in text-books was followed. From July 1, 1891, to Jan. 1, 1895, Schultz's method was used at this laboratory, but it was then decided to change to Timpe's method because it appeared that by making the medium neutral each time before cooking, the chemical changes which take place proceed always under conditions which are more nearly parallel. Experience at this laboratory indicates that the final degree of reaction may be obtained more easily and more accurately by adding a definite number of cubic centimeters of normal acid or alkali to a liter of neutral culture medium, as described in Timpe's method, than by reducing the acidity to the required degree after the first heating, according to Schultz's method, because in the latter case the reaction seems to change during the subsequent process of preparation.

In this connection it should be noted that the degree of reaction has a decided effect on the development of the number of colonies on plates. Mr. J. J. Mackensie finds that (5) for Toronto tap water a nutrient gelatine neutral to phenolphthalein is most favorable. Dr. Johnston (6) found that nutrient gelatine with reaction which corresponds to No. 20 on this scale was favorable. This matter has been discussed in detail in an article published elsewhere, but in order to bring out the great importance of this subject the following table is again presented (2) : —

Table showing a Comparison of Representative Results of the Quantitative Determination of Bacteria in Lawrence Sewage, Merrimack River Water and Lawrence City (Filtered) Water on Gelatine of Different Degrees of Reaction, but with other Conditions the same.

Reaction.*	Lawrence Sewage.		Merrimack River Water.		Lawrence City Water (Filtered).	
	Bacteria per Cubic Centimeter.	Percentage which Numbers are of that obtained with Reaction No. 20.	Bacteria per Cubic Centimeter.	Percentage which Numbers are of that obtained with Reaction No. 20.	Bacteria per Cubic Centimeter.	Percentage which Numbers are of that obtained with Reaction No. 20.
40,	168,000	6	100	1	4	2
35,	448,000	16	400	3	7	3
30,	1,225,000	45	600	4	16	8
25,	1,720,000	64	7,800	55	84	46
20,	2,688,000	100	15,000	100	184	100
15,	2,870,000	106	13,300	89	169	92
10,	2,726,000	101	8,100	54	112	60
5,	2,625,000	98	6,900	46	80	43
0,	2,234,000	86	5,800	38	66	35
—5,	2,342,000	87	4,000	26	58	31
—10,	2,230,000	82	3,200	21	48	26
—15,	1,470,000	54	1,300	9	29	15
—20,	1,290,000	48	500	3	15	8
—25,	1,520,000	56	200	1	13	7

* Numbers refer to cubic centimeters of normal acid or alkali which must be added to a liter of nutrient medium in order to make it neutral to phenolphthalein. Minus (—) means an alkaline solution.

Following the custom practised in this laboratory the reaction of a solution which contains twenty cubic centimeters of normal acid in one liter is known as reaction No. 20. In connection with the preceding table it should be noted that reactions Nos. 18 to 20 were used in the laboratory from 1891 to 1895. The exact degree of reaction was determined at that time by titrating one cubic centimeter of the solution in five cubic centimeters of water. Since January, 1895, reactions Nos. 15 to 18 have been used; and the reaction has been determined by titrating five cubic centimeters of the solution in fifty of water, as already described.

As a result of these experiments it may be said that reactions Nos. 13 to 20 have been found to produce the development of the maximum number of bacteria.

The evidence at hand shows that the degree of reaction which is most favorable for bacterial growth varies somewhat with different

species of bacteria, with bacteria of different degrees of vitality but of the same species (9), and perhaps with the seasons of the year. A factor which should not be neglected is the variable amount of muscle sugar present in different meat infusions, as first pointed out by Dr. Theobald Smith (7). In view of these facts, therefore, reaction No. 18 cannot be said to be the optimum under all conditions, though it seems to come nearest to the optimum reaction so far as Lawrence conditions are concerned. The need and value of a uniform standard degree of reaction is insisted upon, however, for the sake of getting comparable results.

Sterilization and Storage of Culture Media.

Gelatine has been sterilized for thirty minutes on each of three successive days in an Arnold steam sterilizer. It has often been noted, however, that gelatine plates would not solidify, especially in summer weather, and showed evident signs of contamination when sterilized in this manner. To obtain nutrient media which should be sterile every time and to avoid delay caused by heating on three days in succession, an autoclave was obtained in June, 1895. It has been necessary, at the station, to generate steam within the autoclave itself, and this extra heating tends to destroy the power of gelatine to solidify. Agar, and water for purposes of dilution, can be sterilized satisfactorily, however, and at the present time they are always sterilized in this manner.

In order to keep media in good condition a lot of two liters is made up at least once in two weeks, tubed and placed in the ice-chest. To make certain that the media are sterile they are heated for ten minutes in boiling water just before use for plating.

Technique of Plating.

The technique of plating as applied to the bacterial analysis of water consists of mixing a measured amount of the samples of water with a certain amount of gelatinous nutrient medium, with proper precautions, in a Petri double dish, well known to bacteriologists. The method pursued in plating is as follows; after shaking thoroughly the glass bottle (described on page 585) containing the sample of water to be analyzed, one cubic centimeter is drawn out in a pipette graduated to discharge this quantity of water. This measured amount is discharged into a tube of melted nutrient medium (gelatine or agar), and after it has been thoroughly mixed with the food material the contents of the tube are poured into a sterile Petri

dish. As the solution enters the dish it is spread uniformly over the surface and allowed to solidify.

The previous shaking and mixing in the tube divides the bacteria from one another, and, as they lie scattered in the film over the surface of the plate, they are kept separate by the gelatinization of the medium. Under these favorable conditions each cell multiplies by fission and forms an independent colony.

Technique of Counting Colonies of Bacteria on Plates.

Since each bacterium is supposed to be in isolation, and in a position where it may multiply by cell division until a colony is formed, the actual number of individual bacteria which existed in one cubic centimeter of the original sample of water may be determined by counting these colonies. To facilitate the process of counting it is necessary to use special care in spreading the liquid medium in order to obtain a film as nearly uniform in thickness as possible over the whole surface of the plate. When so prepared it is possible to count accurately each colony on a plate containing eight hundred colonies, by the aid of a hand lens and a glass plate ruled with two sets of lines, forming squares one square centimeter in area (Wolffhügel's apparatus).

As the number of colonies increases to three thousand, other methods are employed, such as counting a diametrical section of the plate one centimeter in width. If the colonies on a plate amount to ten thousand or more it is customary to count only those bacteria which lie in three or more areas one centimeter square; these areas must be chosen with care so as to represent an average of the thick, medium and thin portions of the plate. As errors may easily creep in by counting areas which are not average examples of such portions of a plate, it is necessary that much care be taken to select representative areas.

It is essential that the temperature of the melted culture medium should be kept below 39° C. in order to prevent bacteria in the vegetative state from being killed by the heat of the solution. For the purpose of securing a uniform and satisfactory temperature when working with agar it is the custom to have the melted agar kept liquid for one hour before plating, in a water bath maintained at a temperature of 39° C. by an automatic regulator. On the other hand, the temperature of the melted tubes of culture media should not be allowed to become so low that the medium can-

not be poured from the tube readily. At best about five per cent. of the contents remain in the tube after pouring. As long as this percentage is kept constant the results are strictly comparable, although they do not comprise the entire contents of the cubic centimeter of water drawn from the sample for plating.

As Lawrence sewage often contains more than two million bacteria per cubic centimeter, in order to facilitate the estimation of the number of colonies, it is customary to reduce the number which otherwise would appear on a plate by mixing one cubic centimeter of the sample in a flask containing five hundred cubic centimeters of sterilized tap water; the flask is then well shaken, one cubic centimeter taken out and plated in the usual manner. Other samples of water, which contain five thousand or more bacteria in a cubic centimeter, are diluted in the ratio of one to one hundred by a similar process.

When the medium has become solid the plate is placed in a 20° C. thermostat to allow the colonies of bacteria to develop. Agar plates are inverted, to prevent the water of condensation from running over the surface of the medium, otherwise colonies of bacteria which lie on the surface would spread, together with this water, over the surface of the plate.

Agar plates stand in the thermostat for four days; but as certain bacteria peptonise or liquefy gelatine it is necessary to remove some gelatine plates to an ice-chest after forty-eight or sixty hours' growth. The cold temperature checks to a considerable degree the development of liquefying colonies but allows time for the further development of bacteria, which grow slowly.

Owing to the obliteration of small colonies, either by a thick film of bacteria which sometimes spreads over the surface of the medium or by liquefaction of the gelatine, it is possible that error may be introduced in the calculation of the number of colonies on a plate. It is necessary, therefore, to examine frequently and perhaps to count plates which contain such colonies before the normal time for development has expired.

Effect of Length of Period of Cultivation and of Temperature at which Cultivation takes Place.

The length of time during which a plate is allowed to develop and the temperature of the chamber in which the plates stand produce a marked effect on the number of colonies which will develop.

Table showing the Number of Colonies per Cubic Centimeter which had developed on a Plate at Different Periods of Growth.

Source of Sample.	Bacteria per Cubic Centimeter. Temperature, 20 degrees C.			
	1 Day.	2 Days.	3 Days.	4 Days.
Canal water (Merrimack River),	913	8,613	12,317	15,017
City (filtered) water,	3	48	72	87
Effluent from Filter No. 3 B,	0	24	53	64
Sewage,	50,000	4,000,000	4,579,000	4,801,000
Effluent from Filter No. 5,	100	400	900	1,300

Table showing the Number of Colonies of Bacteria per Cubic Centimeter which developed on Plates at Different Degrees of Temperature.

Source of Sample.	Bacteria per Cubic Centimeter. Temperature (degrees centigrade). 20.				30.				37.			
	1 Day.	2 Days.	3 Days.	4 Days.	1 Day.	2 Days.	3 Days.	4 Days	1 Day.	2 Days.	3 Days.	4 Days.
Canal water,	3.200	14.400	17.100	18.200	8.400	15.100	17.700	18.100	8.800	11.500	12.200	12.700
City (filtered) water,	3	62	83	89	30	71	76	82	28	36	41	44

Note. — These numbers are averages, in each instance, of sixteen sets of determinations made on separate days in June and July, 1895; all of the plates comprising a set on any special day having been made from a single sample of canal or city water.

Experiments have been made to test the effect produced by allowing plates to develop for a longer period. The power which some bacteria possess to liquefy gelatine or to form an opaque growth over a considerable portion of agar often makes it impossible to keep plates more than four days. An increase has been noted, however, in several instances when plates were allowed to develop for ten days. As the work at Lawrence calls for many plates containg liquefying and spreading colonies it has been thought best to adopt a rule which should secure, for purposes of comparison, counts of plates under conditions as nearly parallel as possible. For this reason plates have always been counted on the fourth day. It sometimes happens, however, that plates which have been partially liquefied or contain spreading colonies present a smaller number of colonies on the fourth than on the third day. Under such conditions the highest number has been taken.

Comparison of the Relative Value of Gelatine and Glycerine Agar for Quantitative Bacterial Work.

Work at the Lawrence Experiment Station often has to deal with samples of sewage and water which contain large numbers of bacteria. Many of these bacteria liquefy gelatine plates. The nutrient gelatine itself has been found to melt if the plates are allowed to stand a short time on the laboratory table in hot weather, thereby causing the value of counts on gelatine plates to be much impaired. As the gelatine did not melt in cold weather it was possible to count the bacteria more accurately, and therefore determinations made at different seasons of the year were not as comparable as desired. Reference has already been made to the difficulty experienced in sterilizing gelatine.

Glycerine agar was found as a result of long experiment to be a medium which would give a maximum number of colonies at all seasons of the year, a medium in which sewage bacteria could grow rapidly without being able to liquefy it, and a medium which could be heated in our autoclave until sterile without losing its power of solidification. Moreover, it was found that, by careful observation of necessary precautions, agar would give results which compared favorably with gelatine and often gave better results than gelatine in summer. For these reasons it was decided to substitute glycerine agar for gelatine in a considerable portion of the work, while making frequent control cultures with ordinary nutrient gelatine.

Table showing a Comparison of the Number of Bacteria per Cubic Centimeter obtained from Gelatine and Glycerine Agar.

Date.	Sewage.		Effluent from Sewage Filters.		Canal Water.		Effluent from Canal Water Filters.	
	Gelatine.	Glycerine Agar.	Gelatine.	Glycerine Agar.	Gelatine.	Glycerine Agar.	Gelatine.	Glycerine Agar.
1894.								
January, . .	749,000	731,000	-	-	7,800	5,500	56	45
March, . .	586,000	563,000	-	-	1,737	1,683	62	62
July, . . .	-	-	-	-	-	-	85	126
1895.								
November, .	3,077,000	2,812,000	-	-	8,500	7,100	61	68
December, .	6,400,000	6,200,000	440,400	394,000	11,900	10,700	58	57
1896.								
January, . .	2,150,000	1,995,000	287,000	238,000	9,500	9,600	34	43
March, . .	2,495,000	2,135,000	179,000	149,000	5,950	6,150	85	87
May, . . .	4,490,000	4,630,000	251	269	5,200	5,500	34	34

NOTE. — The numbers given in this table are averages of numerous determinations. The plates were allowed to develop from three to four days. The low numbers given in certain instances for gelatine plates are due to liquefaction of the gelatine.

It was known that results were sometimes higher on gelatine than on glycerine agar, as indicated in this table, and that the development on the former medium is somewhat more rapid, but it was believed that glycerine agar under the actual conditions gave results which for all seasons of the year were more nearly comparable. Numerous comparative results have been obtained at frequent intervals, and the earlier data have been confirmed in a general way.

Roll Cultures in Four-liter Bottles.

Reference has already been made to the use of peptone glucose solutions (one-tenth per cent. peptone and two-tenths per cent. of glucose in tap water) containing a pure culture of *Bacillus prodigiosus* for testing the efficiency of sand filters. A measured quantity of the solution containing large numbers of this germ is mixed with the water on the surface of the filter. The amount of solution applied varies with the area of the filter, rate of filtration and other conditions. As this bacillus has not been found to occur naturally in Lawrence waters it is used to test the power of filters to remove bacteria, because any *B. prodigiosus* cells which appear in the effluent must have passed through the sand in the filter. Further, it has been learned by numerous experiments that this germ does not grow within filters, and in this respect it differs from many common water bacteria and resembles the germ of typhoid fever. Still another advantage in the use of *B. prodigiosus* lies in the ease with which it may be identified. By the determination of the exact number of cells of *Bacillus prodigiosus* applied and the number which appear in the effluent it is possible to obtain valuable tests upon the efficiency of the filter both quantitatively and qualitatively.

The effluent of some of the Lawrence experimental water filters amounts to twenty thousand gallons of water in a day. It is impossible to examine all of such effluents and yet it is desirable to test them as thoroughly as possible. This is usually done by taking samples at frequent intervals during the day. But in the application of *B. typhosus* and *B. prodigiosus* to many of the filters it has been found that a large number of the plates seeded with one cubic centimeter of effluent do not contain any of those specific germs which have been added to the water as it enters the filter. In other words, there are fewer than one bacteria of this kind per cubic centimeter. Circumstances have been such that it has been desirable to study more thoroughly the presence of the specific germ in the effluent, and to learn, for

instance, whether the average number would be 0.1 or 0.01 per cubic centimeter. To accomplish this purpose fifty cubic centimeters of effluent are mixed with one hundred cubic centimeters of gelatine (twenty per cent. of gelatine in one liter) in a four-liter bottle. By rolling the bottle as it lies on its side on a cake of ice the fifty cubic centimeters mixed together with the gelatine are distributed over the large inner surface of the bottle.

The advantage of using this method to test waters for a certain species is great when the total number of bacteria is small, because it is possible to analyze a large number of cubic centimeters of effluent at one time and yet have the single colonies isolated.

Table showing Results of Examinations by Roll Table Method for Bacillus Prodigiosus in the Effluent of Water Filters.

DATE — 1895.	Number of Filter.	Depth of Filter. (Inches.)	*Bacillus Prodigiosus.* applied per Cubic Centimeter.	Quantity of Effluent examined (Cubic Centimeters).	Number of Colonies of *Bacillus Prodigiosus.* found.
September 2,	7 A	24	347	50	0
2,	3 B	60	347	50	0
2,	3 B	60	347	50	0
3,	3 B	60	424	50	0
3,	7 A	24	424	50	3
3,	8 A	60	424	50	0
7,	3 B	60	382	50	0
7,	7 A	60	382	50	5
7,	8 A	60	382	50	0
23,	3 B	60	429	50	0
23,	8 A	60	429	50	0
October 2,	3 B	60	376	50	0
2,	8 A	60	376	50	0
7,	3 B	60	565	50	0
7,	8 A	60	565	50	0
8,	3 B	60	329	50	0
8,	8 A	60	329	50	0

REFERENCES.

(1) Special Report of the Massachusetts State Board of Health, 1890, p. 811.
(2) Fuller, Journal of American Public Health Association, 1895, Vol. XX, pp. 381-399.
(3) Schultz, Centralblatt für Bacteriologie, 1891, X, 53.
(4) Timpe, Centralblatt für Bacteriologie, XIV, XV, XVII.
(5) Mackensie, Journal of American Public Health Association, 1895, Vol. XX, p. 427.
(6) Johnston, Journal of American Public Health Association, 1895, Vol. XX, p. 478.
(7) Smith, Wilder Quarter-Century Book, 1893, p. 195.
(8) Sedgwick and S. C. Prescott, Journal of American Public Health Association, Vol. XX, 1895, pp. 450-458.
(9) Fuller, Annual Report of the Massachusetts State Board of Health, 1891, pp. 638-644.

SEWAGE PURIFICATION

OF

CITIES AND TOWNS IN MASSACHUSETTS.

SEWAGE PURIFICATION OF CITIES AND TOWNS IN MASSACHUSETTS.

In order to learn the results obtained by the systems of sewage disposal in the cities and towns in Massachusetts which have adopted a method of sewage purification, the State Board of Health since 1892 has caused chemical analyses to be made of sewage and effluent from many of the systems now in operation.

The results for the year 1892 were printed in connection with a paper upon the "Sewage disposal of cities and towns in Massasetts by intermittent filtration," in the annual report of the State Board of Health for that year, containing chemical analyses of the sewage and effluent from the works at the three places described, viz., Framingham, Marlborough and Gardner. In the annual report of the Board for the year 1893 there appeared a corresponding paper, in which were given the results of analyses of sewage and effluent up to Jan. 1, 1894, from these three and several additional sewage-purification plants, together with a brief description of each of the systems.

In the present paper will be found analyses made during the years 1894 and 1895 of the sewage and effluents from the works at Amherst, Brockton, Framingham, Gardner, Marlborough and Medfield. A short description of the works at each place is given in connection with the analyses, and in some cases statements made in previous reports are repeated.

The first plant for the disposal of town sewage by filtration in Massachusetts was constructed at Lenox in 1876. A system for the disposal of the sewage of a portion of the town of Amherst, partly by filtration but chiefly by irrigation, was constructed about 1881, and a small system for the disposal of sewage by intermittent filtration was introduced at Medfield in 1886. Since the last date the towns of Framingham, Gardner and Westborough and the cities of Marlborough and Brockton have constructed and are now operating works for the disposal of sewage by intermittent

filtration, and a new disposal field has been constructed and is in use at Lenox. At North Brookfield there is a small system of sewage disposal by irrigation and filtration. There are also in the State several large institutions which dispose of their sewage by intermittent filtration.

The sewage of the city of Worcester is treated with chemicals, and the method has been fully described under "Blackstone River," in the chapters on the examination of rivers in previous reports of the Board, and on page 367 of this volume. Analyses made by the chemists at Worcester, showing the results obtained at the chemical precipitation works there, have already been given on page 372 of the report for 1894 and on page 360 of the present report.

In addition to the analyses given in the following pages, there have also been collected hourly samples of sewage, representing the entire flow for twenty-four hours in the main sewers at Framingham, Gardner, Marlborough and the Worcester Lunatic Asylum. The results of chemical and bacterial analyses of these samples have been presented and discussed in the chapter on the composition of sewage, in the report of the investigation upon the purification of sewage at the Lawrence experiment station, on page 462 of the annual report for 1894 and on page 452 of this volume.

Sewage Disposal at Amherst.

The population of the town in 1895 was 4,785. Sewerage facilities have been provided only for portions of the main village, and the sewage is disposed of by two systems.

The first system, begun in 1881 and subsequently extended, collects the sewage from about 1,000 persons. The system is of the so-called "separate" type, which provides for house sewage only. The sewage flows to a settling tank about a mile south-east of the village, and thence through a pipe 520 feet long into Fort River. The settling tank into which it discharges has two compartments, each 10 feet wide, 15 feet long and 6 feet deep, constructed of stone laid in cement. The main sewer, which is 10 inches in diameter, branches just before it enters the tank, so that the sewage may be diverted into either compartment separately, delivering it at the surface of the sewage in the tank, which is about 1 foot below the top of the tank. The sewage is not screened, but the mouth of the outlet pipe turns downwards below the surface of

the sewage, so that some of the floating matter is retained in the tank. At irregular intervals the sludge is removed and mixed with soil, to be used as a fertilizer on the adjoining fields.

In the annexed table are the results of analyses of sewage before and after passage through the tank. It is to be noted that the effluent appears to represent sewage more dilute than that collected from the inlet pipe, so that the apparent purification was probably greater than that which actually took place. Analyses are also given of Fort River above and below the point of discharge of the effluent pipe.

The second system, which was begun in 1886, takes the sewage from a part of the thickly populated portion of the town, north of the town hall, to a settling tank and irrigation field half a mile north of the village. A description of this system, with results of analyses of sewage and effluent, was presented in the annual report for 1893. No analyses of the sewage or effluent have been made since that time.

Chemical Examination of Sewage from Amherst.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total Residue. Total.	Total Residue. Dis-solved.	Total Residue. Sus-pended.	Loss on Ignition. Total.	Loss on Ignition. Dis-solved.	Loss on Ignition. Sus-pended.
	1894.									
11654	Jan. 18.	Decided, milky.	Heavy.	0.70	19.40	12.20	7.20	9.80	4.60	5.20
11655	Jan. 18.	Distinct, milky.	Cons.	0.55	13.00	9.40	3.60	5.60	2.80	2.80

Chemical Examination of Sewage from Amherst — Concluded.

[Parts per 100,000.]

Ammonia. Free.	Ammonia. Albuminoid. Total.	Albuminoid. Dis-solved.	Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed. Unfiltered.	Oxygen Consumed. Filtered.	Iron. Unfiltered.	Iron. Filtered.	Hardness.
1.3200	.2180	.1000	.1180	2.40	.0100	.0040	2.3068	1.6432	.0740	.0100	1.9
0.5360	.0980	.0380	.0600	1.58	.0100	.0020	1.3272	0.8848	.0400	.0240	1.8

Odor, offensive.——The first sample was collected from the main sewer, before it enters the settling tank; the last, from the pipe which conveys the sewage from the settling tank to Fort River.

Chemical Examination of Water from Fort River, Above and Below the Outlet of the Sewer from Amherst.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended		Nitrates.	Nitrites.		
	1894.														
11656	Jan. 18	Slight.	Slight, earthy.	0.28	3.75	1.15	.0018	.0028	.0018	.0010	.19	.0050	.0001	.2702	0.8
11657	Jan. 18	Slight.	Slight.	0.28	4.05	1.40	.0160	.0060	.0048	.0012	.26	.0030	.0002	.3745	0.8

Odor, none. On heating, the odor of the second sample was distinctly disagreeable. —— The first sample was collected from the river, about 100 feet above the sewer outlet; the last, from the river about 200 feet below the sewer outlet.

Sewage Disposal at Brockton.

The sewage disposal system of the city of Brockton (population in 1895, 33,165) was first put in operation in November, 1894, and at the close of that year there had been a few connections made with the sewers. At the end of December, 1895, there were 221 connections, 110 of which were from dwelling-houses, 67 from factories and the remainder from business blocks, hotels and public buildings. The total length of sewers constructed to the end of the year 1895, including the main sewer, was 13.82 miles.

The principal industry in Brockton is the manufacture of shoes. The city is situated largely in the valley of the Salisbury Plain River, into which nearly all of the drainage naturally flows, and a large proportion of the population is in the immediate vicinity of the stream. The watershed of the river just below the city is only about 16 square miles, and the sewage of the city could not be discharged into it without creating a nuisance.

The system of sewerage adopted is what is known as the separate system, and as it was necessary in this case to pump all of the sewage, all surface water has been excluded from the system and great care has been taken to exclude ground water both from the street sewers and the house connections. Under-drains were constructed beneath all sewers, during the construction of which ground water was en-

countered, and special care was taken to make all joints tight. The under-drains discharge directly into the river or its tributaries at convenient points. The main or intercepting sewer is laid in low land bordering the river; it is egg-shaped in section, and at its lower end its size is 32 inches by 48 inches. At times of high water there is considerable leakage into it, and before any sewage was admitted to the sewers there was a large flow of ground water from the outlet of the intercepting sewer.

The sewage passes from the intercepting sewer at the pumping station into a covered masonry reservoir 110 feet long by 44 feet wide, having a capacity of about 500,000 gallons, sufficient to store the night flow of sewage and making it necessary to pump only during the day. The reservoir is ventilated by means of a 15-inch pipe connecting with the chimney of the pumping station. Between the reservoir and the pumps the sewage is screened by passing between iron plates placed so as to have an open space between them of three-fourths of an inch. From the pumping station the sewage is forced through a cast-iron force main 24 inches in diameter and nearly 17,000 feet in length to the filtration area.

The filtration area is situated in the south-westerly corner of the city, and comprises about 30 acres, being a part of a large area of flat, sandy land, locally known as the "muster field," the greater part of which is situated within the limits of the town of Easton. On this field 23 filter-beds have been prepared, having an average area, exclusive of embankments, of 1 acre. The loam was removed from all the beds. The subsoil was entirely removed from 12 of the beds, partially removed from 6, while in 5 of the beds the subsoil remains over the sand. The loam and subsoil which was removed was used in making the embankments between the beds. The filtering material varies from a fine gravel to a very fine sand, with the coarser material generally nearest the surface.

Under 10 of the beds a stratum of clay was found at a depth of from 7 to 8 feet, and in these beds 4 lines of 5-inch under-drains were constructed just above the clay, discharging through a 15-inch pipe into a small brook, a tributary of the Taunton River.

Although provision was made for the separation and removal of a portion of the solid matter from the sewage at the reservoir, there has as yet been no necessity for such separation, as the amount of sewage is so small that all of it can be disposed of on the beds.

An agitator has been placed in the bottom of the reservoir, through which sewage from the force main is introduced under pressure and by means of which all the solid matter which may have collected on the bottom may be thoroughly mixed with the liquid portion of the sewage and thus conveyed to the pumps. In the early operation of the plant it was the custom to start the agitator when the pumps were started and there was a large body of sewage in the reservoir, but by this method the sludge was distributed through the whole volume of sewage, and it was found that the beds soon became clogged. At the present time the agitator is put in operation just before the reservoir is emptied, and consequently the entire body of sludge, mixed with a small amount of sewage, is delivered at the field at once. Except when crops are being grown the sludge is discharged upon a separate bed, and when thoroughly dried the residue is raked up and burned.

The force main is so constructed that for about one-quarter of its length the pipe slopes towards the beds; but when the pumps are not running there are about 250,000 gallons remaining in the end of the pipe nearest the pumping station, which amount is stored there until pumping is resumed. When the daily amount of sewage pumped is less than 250,000 gallons, none of the sewage pumped into the force main one day reaches the filtration area until the next day, and consequently it has become quite stale when it is applied to the beds.

The method of operation has been to apply about 80,000 gallons of sewage to one bed, and then allow the filter to rest for a day before another dose is applied. During times of high flow in the sewers the size of the dose is much increased, but it is said that there has been no difficulty in disposing of all of the sewage, and 4 of the 23 beds have never been used.

During the winter of 1894–95 some of the beds were left with level surfaces; but it was found that in these beds the surface froze to such an extent that sewage could not be disposed of upon them, and the only beds which could be used during the cold weather were those which had been furrowed during the preceding fall. Accordingly all of the beds in use during the winter of 1895–96 were furrowed, and notwithstanding the low temperature of the sewage when received at the field, no difficulty was experienced from freezing.

The following table, taken from the report of the city engineer of Brockton for 1895, gives the average amount of sewage disposed of and the temperature of the sewage as it reaches the beds : —

Month.	Average Daily Flow at Field (Gallons).	Temperature Sewage at Field.	Month.	Average Daily Flow at Field (Gallons).	Temperature Sewage at Field.
January,	215,000	42.6	July,	195,000	60.8
February,	109,000	40.6	August,	273,000	64.0
March,	142,000	39.5	September,	275,000	64.0
April,	250,000	42.3	October,	488,000	57.0
May,	338,000	53.5	November,	474,000	51.0
June,	228,000	60.1			

Chemical Examination of Sewage from Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
					Total Residue.			Loss on Ignition.		
		Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
13814	1895. Feb. 12.	Thick.	Heavy, black.	–	84.40	40.20	44.20	38.00	12.40	25.60

Chemical Examination of Sewage from Brockton — Concluded.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.		Iron.		Hardness.
	Albuminoid.										
Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.	
3.4560	.9100	.2440	.6660	9.05	.0000	.0000	8.5600	3.1200	.3200	.0800	6.4

Odor, offensive. —— The sample was collected as the sewage flowed out upon the filter beds.

Chemical Examination of Effluent from the Under-drain at the Brockton Sewage Disposal Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
13815	1895. Feb. 12	None.	None.	.01	4.00	.0248	.0038	.75	.0450	.0000	.0240	0.6	.0000

Odor, none.—— The sample was collected from the under-drain near Pearl Street, and contains a large amount of ground water.

Sewage Disposal at Framingham.

The town of Framingham (population in 1895, 9,512) contains three villages, of which South Framingham is by far the most populous, and up to the present time is the only village sewered.

The sewerage system was put in operation near the end of the year 1889, and at the end of 1895 about 800 dwelling-houses and 50 business blocks, stores, factories, etc., were connected with the sewer. In addition to this, the sewage of the Women's Prison (population, about 350), located in the town of Sherborn just beyond the Framingham line, enters this system. The storm water is excluded from the sewers, and a continuous system of under-drains was laid beneath the principal sewers to collect and carry off the ground water. The amount of sewage flowing during a season of high rainfall, however, is fully three times the ordinary flow. The main under-drain, which formerly discharged into a brook feeding Lake Cochituate, now discharges into an open reservoir near the pumping station, from which it is pumped to some specially prepared filter-beds a short distance away from the station. The average daily amount of sewage pumped and purified during 1895 was about 400,000 gallons.

The sewage is collected in a pair of receiving reservoirs having a total capacity of 431,000 gallons, from which it is pumped through a cast-iron main, 12 inches in diameter and 9,740 feet in length, to the filtration area, located about 2½ miles north-east of the village of South Framingham. This area, a more detailed description of which, accompanied by a plan, may be found on page 560 of the annual

report of the Board for 1892, covers about 70 acres, much of which is quite level. The field is at an elevation of about 20 feet above Bannister Brook, which flows along its north-westerly border.

Three new filters, having an area of 4 acres, were constructed during the year 1894, making 13 beds with a total area of about 16 acres which have been specially prepared for sewage. About half of this area is under-drained to a limited extent.

During the summer nearly all of the filter-beds are planted with field corn (maize), and very satisfactory crops are obtained. A few other crops were raised to a small extent, some of which have been fairly satisfactory. The old beds upon which corn was grown were not disturbed after the last hoeing in the early part of July, and they have been found to give satisfactory results in cold weather, owing to the arrangement of the surfaces in hills and furrows, thus enabling a covering of snow and ice to rest on the hills, and reducing the exposure of the material in the furrows to frost.

The quality of the sewage and effluent from several different places may be seen by the tables of analyses on the following pages. The sewage is ordinary town sewage, discolored and somewhat modified at times by a considerable amount of spent dyes discharged into the sewers from the straw-goods factories in the town.

For the results of chemical and bacterial analyses, showing the variations at different hours of the day in composition of the summer sewage, and measurements of its quantity, reference is made to page 469 of the annual report for 1894 and to page 456 of this volume.

Chemical Examination of

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.*	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1894.									
1	11593	Jan. 3	Decided, milky.	Cons., dark.	0.50	35.40	30.00	5.40	15.80	10.80	5.00
2	11658	Jan. 18	Thick.	Heavy, dark.	–	39.00	31.20	7.80	16.80	11.20	5.60
3	11771	Feb. 12	Thick.	Cons., dark.	–	36.00	29.40	6.60	13.40	7.60	5.80
4	11907	Mar. 15	Decided.	Heavy, gray.	0.90	30.80	24.00	6.80	9.00	4.80	4.20
5	11949	Mar. 27	Thick.	Cons., dark.	0.60	57.20	30.00	27.20	30.60	5.00	25.60
6	12022	April 10	Decided, milky.	Heavy, gray.	0.50	103.60	32.40	71.20	76.60	12.80	63.80
7	12107	April 26	Decided.	Heavy, gray.	0.90	31.60	26.60	5.00	11.00	7.00	4.00
8	12193	May 10	Decided, milky.	Cons., dark.	–	31.20	27.60	3.60	11.20	8.60	2.60
9	12347	June 11	Thick.	Heavy, dark.	–	115.20	33.00	82.20	82.40	11.60	70.80
10	12510	July 10	Thick.	V. heavy, dark.	–	139.00	62.60	76.40	87.80	22.00	65.80
11	12709	Aug. 10	Thick, dark.	Heavy, black.	–	58.00	31.80	26.20	31.20	9.60	21.60
12	12952	Sept. 12	Thick.	V. heavy, dark.	1.30	51.60	39.20	12.40	26.00	15.20	10.80
13	13087	Oct. 5	Thick.	Cons., dark.	1.00	47.40	41.80	5.60	19.40	14.00	5.40
14	13361	Nov. 21	Thick.	Cons., white.	0.40	33.90	29.10	4.80	12.50	8.30	4.20
15	13536	Dec. 21	Decided.	Cons., gray.	1.20	31.30	23.70	7.60	10.20	7.30	2.90
16	Av.	....	....	....	–	57.70	33.78	23.92	31.17	10.83	20.33
		1895.									
17	13642	Jan. 12	Decided.	Heavy, black.	1.40	35.30	28.80	6.50	14.20	8.80	5.40
18	13721	Jan. 23	Decided.	Cons., gray.	0.40	73.80	23.70	50.10	55.20	6.40	48.80
19	13787	Feb. 9	Decided.	Cons., gray.	0.90	32.50	22.10	10.40	12.90	4.00	8.90
20	14071	April 1	Decided.	Heavy, dark.	–	37.80	28.10	9.70	16.90	8.90	8.00
21	14129	April 10	Decided.	Heavy, gray.	0.40	115.40	32.70	82.70	88.20	11.70	76.50
22	14318	May 17	Decided.	Heavy, dark.	–	59.60	29.40	30.20	33.00	9.40	23.60
23	14462	June 11	Decided.	Heavy, gray and dark.	–	50.80	39.90	10.90	21.90	13.60	8.30
24	14671	July 22	Decided.	Heavy, gray.	–	38.40	34.60	3.80	15.20	10.60	4.60
25	14803	Aug. 12	Thick.	Heavy, dark.	0.40	39.20	31.60	7.60	21.00	13.40	7.60
26	15198	Sept. 17	Thick.	Cons., dark.	0.60	42.10	34.50	7.60	17.40	12.20	5.20
27	15379	Oct. 16	Thick.	Heavy, black.	–	367.40	27.60	339.80	289.40	8.20	281.20
28	15512	Nov. 11	Decided, milky and floc.	Cons., coarse and floc.	0.20	25.40	22.40	3.00	9.00	6.80	2.20
29	15715	Dec. 10	Decided, milky.	Cons.	0.60	57.80	28.20	29.60	36.00	8.80	27.20
30	15807	Dec. 26	Decided, milky.	Cons., dark.	0.35	38.80	22.60	16.20	18.80	5.00	13.80
31	Av.	....	....	....	–	75.95	29.55	46.41	48.92	9.44	39.48

* The color of many samples was affected by the presence of spent dye liquors in the sewage, and in many cases could not be determined satisfactorily.

Sewage from Framingham.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.		Iron.			
	Albuminoid.											
Free.	Total.	Dis-solved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.	Hardness.	
1.9200	0.3180	.1900	.1280	4.00	.0000	.0000	3.8610	3.0810	.0560	.0560	5.3	1
1.9920	0.3560	.2280	.1280	5.02	.0000	.0000	5.7196	4.2976	.1360	.0880	5.3	2
2.1760	0.3900	.3020	.0880	3.79	.0000	.0000	3.5200	2.4800	.1080	.0700	5.4	3
1.3440	0.2880	.1520	.1360	3.97	.0050	.0400	3.1040	2.0800	.1400	.0760	7.3	4
1.6000	0.4660	.2820	.1840	4.40	.0050	.0000	5.3900	3.8885	.1000	.0900	6.6	5
1.7600	0.7500	.3740	.3760	4.34	.0050	.0000	6.1857	2.6465	.2800	.0640	7.3	6
1.0560	0.2620	.1480	.1140	4.41	.0000	.0600	3.3259	2.3937	.1000	.0640	6.4	7
1.2160	0.2880	.2020	.0860	3.63	.0000	.0000	2.8700	2.0500	.0920	.0720	6.1	8
2.0160	0.6160	.2080	.4080	5.53	.0000	.0000	3.6652	2.3100	-	-	7.4	9
4.4000	1.0440	.3520	.6920	10.00	.0000	.0000	-	4.0117	-	-	11.0	10
2.4000	0.9360	.2080	.7280	7.20	.0000	.0000	5.3130	1.5400	-	-	5.4	11
4.5000	0.4800	.2440	.2360	7.25	.0000	.0000	3.7268	2.2176	.0900	.0500	5.1	12
3.8400	0.3860	.3060	.0800	9.00	.0000	.0000	5.7670	2.8835	.0920	.0600	5.0	13
1.7920	0.3720	.2240	.1480	5.60	.0000	.0000	2.9250	1.6380	.0920	.0540	5.7	14
2.0800	0.4300	.2760	.1540	5.22	.0000	.0000	3.0800	2.5025	.0600	.0300	5.9	15
2.4380	0.5135	.2508	.2627	5.86	.0006	.0042	4.0600	2.5689	.1044	.0617	6.4	16
1.9200	0.4320	.2860	0.1360	4.83	.0000	.0000	3.9500	2.6070	.0650	.0380	8.1	17
1.6640	0.3560	.1980	0.1580	4.38	.0000	.0010	2.7255	1.6195	.1120	.0400	6.3	18
1.6320	0.3100	.2440	0.0660	4.40	.0000	.0090	4.1600	2.4960	.1300	.0570	5.7	19
1.9200	0.5200	.2780	0.2420	4.90	.0000	.0000	3.6190	2.3100	.0650	.0300	8.1	20
1.8240	0.6760	.3000	0.3760	4.40	.0000	.0000	6.2755	2.8105	.1400	.0350	6.4	21
2.6240	0.6780	.2980	0.3800	6.00	.0000	.0000	7.3075	3.0415	.1760	.0520	7.9	22
11.0080	0.4720	.1960	0.2760	8.60	.0000	.0000	4.7424	2.6520	.1250	.0600	7.0	23
2.5600	0.3420	.2160	0.1260	7.10	.0000	.0000	2.3625	1.9875	.0900	.0800	6.9	24
1.9840	0.2800	.1540	0.1260	6.60	.0000	.0000	2.9640	1.6770	.1160	.0600	7.4	25
3.9680	0.4240	.2080	0.2160	7.45	.0000	.0000	4.3290	2.3556	-	-	5.6	26
0.8000	3.6300	.1500	3.4800	3.95	.0000	.0000	25.3890	2.4180	.7300	.0940	8.0	27
0.7680	0.1900	.0840	0.1060	3.60	.0050	.0830	1.6770	0.8190	.0680	.0560	7.0	28
1.8240	0.5080	.2040	0.3040	4.15	.0400	.0400	6.1230	2.7690	.0600	.0400	7.7	29
1.6320	0.4260	.2540	0.1720	4.16	.0000	.0000	3.3110	1.5246	.1360	.0460	6.6	30
2.7173	0.6986	.2166	0.4820	5.48	.0021	.0094	5.9067	2.2356	.1522	.0551	7.0	31

Odor, offensive.——The sewage was collected as it flowed out upon the filter-beds.

Chemical Examination of Effluent from the East

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11595	Jan. 3	Slight, scum.	Slight.	.00	None.	Very faint or none.	25.30
2	11660	Jan. 18	None.	None.	.00	Very faint or none.	Faintly musty.	23.70
3	11773	Feb. 12	Very slight.	Very slight.	.02	Distinctly musty.	Faintly musty.	20.80
4	11909	Mar. 15	Very slight.	Very slight.	.01	Faintly musty.	Decidedly musty.	18.40
5	11951	Mar. 27	None.	Very slight.	.01	Faintly musty.	Decidedly musty.	18.50
6	12024	April 10	None.	Cons.	.00	Distinctly musty.	Decidedly musty.	21.40
7	12109	April 26	None.	Very slight.	.02	Very faint or none.	Very faintly musty.	21.70
8	12195	May 10	Distinct.	Slight.	.15	Decidedly musty.	Decidedly musty.	19.70
9	12349	June 11	Very slight.	Very slight.	.04	Distinctly musty.	Decidedly musty and disagreeable.	25.50
10	12512	July 10	None.	Slight, rusty.	.02	Faintly musty.	Faintly musty.	29.40
11	12711	Aug. 10	None.	Very slight.	.02	None.	None.	37.60
12	12953	Sept. 12	None.	Slight, earthy.	.02	Faintly musty.	Very faint or none.	28.00
13	13089	Oct. 5	Slight.	Slight.	.03	None.	Faintly musty.	30.90
14	13362	Nov. 21	None.	Very slight.	.02	Very faintly musty.	Decidedly musty.	28.70
15	13538	Dec. 21	Very slight.	Slight.	.01	Distinctly musty.	Distinctly musty.	25.00
16	Av.	....	....	....	.03	....	....	25.84
		1895.						
17	13644	Jan. 12	None.	None.	.04	Faintly earthy.	Distinctly musty.	26.00
18	13723	Jan. 23	Very slight.	Cons., sand.	.03	Distinctly musty and disagreeable.	Decidedly musty.	25.50
19	13788	Feb. 9	Very slight.	None.	.01	Decidedly disagreeable and musty.	Decidedly musty.	23.60
20	14072	April 1	Slight.	Cons.	.12	Offensive.	Offensive.	20.60
21	14130	April 10	Very slight.	Very slight.	.03	Offensive.	Offensive.	20.80
22	14320	May 17	Very slight.	Very slight.	.02	Faintly musty and disagreeable.	Decidedly musty and disagreeable.	26.90
23	14464	June 11	None.	Very slight.	.02	Decidedly musty.	Decidedly musty and disagreeable.	41.20
24	14673	July 22	None.	Slight, sand.	.02	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	41.50
25	14805	Aug. 12	None.	None.	.00	Very faintly musty.	Distinctly musty.	40.60
26	15200	Sept. 17	None.	None.	.02	None.	Very faintly musty.	34.20
27	15381	Oct. 16	Very slight.	Very slight.	.10	None.	Very faint or none.	28.60
28	15514	Nov. 11	None.	None.	.05	None.	Distinctly musty.	23.40
29	15717	Dec. 10	Very slight.	Slight.	.02	None.	Distinctly musty.	22.60
30	15809	Dec. 26	None.	None.	.00	None.	None.	22.70
31	Av.	....	....	....	.04	....	....	29.15

The samples were collected from

Under-drain of the Framingham Filter-beds.

[Parts per 100,000.]

Ammonia.			Nitrogen as					
Free.	Albu-minoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.	
.0480	.0140	3.57	1.2500	.0045	.0975	5.4	.0050	1
.0920	.0000	3.84	0.7500	.0020	.1059	5.4	.0000	2
.0320	.0064	3.42	0.7000	.0040	.1136	5.1	.0040	3
.0400	.0072	2.75	0.7000	.0030	.1120	3.9	.0160	4
.0320	.0050	2.98	1.0000	.0070	.1078	4.9	.0050	5
.0200	.0070	3.19	0.5000	.0030	.1185	4.6	.0000	6
.0480	.0080	3.62	1.1500	.0020	.1161	5.0	.0020	7
.0350	.0080	3.42	0.5000	.0040	.2230	5.1	.0500	8
.0840	.0180	3.77	0.9300	.0080	.1317	5.7	-	9
.0140	.0062	4.79	1.2200	.0010	.1817	5.8	.0000	10
.0190	.0090	5.20	2.5000	.0020	.0693	7.7	.0050	11
.0480	.0040	4.85	1.3250	.0030	.1001	4.7	.0100	12
.0640	.0080	5.81	1.8750	.0030	.1066	5.7	.0130	13
.0086	.0054	6.00	1.0000	.0005	.1108	6.6	.0020	14
.1160	.0210	5.16	0.1800	.0020	.1155	4.9	.0150	15
.0467	.0089	4.37	1.0754	.0032	.1234	5.5	.0103	16
.0760	.0140	5.22	0.8750	.0014	.1422	6.3	.0020	17
.2400	.0200	5.00	0.7500	.0180	.2172	5.3	.0020	18
.2800	.0180	4.95	0.4750	.0080	.2544	5.6	.0010	19
.5920	.0100	3.90	0.2900	.0130	.2502	5.1	.0700	20
.4000	.0110	3.95	0.4750	.0030	.1925	4.7	.0280	21
.3920	.0060	3.70	1.2500	.0020	.1580	6.6	.0010	22
.4800	.0050	4.00	2.2500	.0050	.1599	9.1	.0020	23
.3200	.0030	5.15	2.5000	.0040	.1312	10.1	.0030	24
.2000	.0080	5.60	1.7000	.0020	.1326	9.6	.0000	25
.1080	.0000	6.00	2.0000	.0050	.1092	7.1	.0010	26
.0720	.0130	6.25	0.9500	.0020	.1521	7.0	.0430	27
.0440	.0058	4.80	1.2400	.0130	.0920	4.7	.0080	28
.0400	.0070	3.88	0.6800	.0010	.1264	5.6	.0100	29
.0202	.0042	4.12	0.8000	.0013	.0539	5.4	.0020	30
.2563	.0085	4.78	1.2235	.0057	.1585	6.7	.0137	31

the under-drain at its outlet.

Chemical Examination of Effluent from the West

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11594	Jan. 3	None.	Slight.	.00	Very faintly musty.	Distinctly musty.	25.90
2	11659	Jan. 18	Very slight.	Very slight.	.00	Very faint or none.	Distinctly musty and mouldy.	23.50
3	11772	Feb. 13	Slight.	Slight.	.02	Faintly musty.	Faintly musty.	22.30
4	11908	Mar. 15	None.	Very slight.	.01	Decidedly musty.	Decidedly musty.	19.40
5	11950	Mar. 27	None.	Very slight.	.01	Very faintly musty.	Faintly musty.	20.40
6	12023	April 10	None.	Cons.	.02	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	16.00
7	12108	April 26	Very slight.	Slight, white.	.02	Very faintly musty.	Very faintly musty.	21.30
8	12194	May 10	Very slight.	Slight.	.00	Decidedly musty.	Faintly musty.	22.30
9	12348	June 11	Slight.	Slight.	.02	Faintly mouldy.	Decidedly mouldy.	27.30
10	12511	July 10	None.	Very slight.	.02	Faintly musty.	Distinctly musty.	33.50
11	12710	Aug. 10	None.	Very slight.	.04	None.	Faintly musty.	33.10
12	12954	Sept. 12	None.	Slight, green.	.07	None.	None.	33.20
13	13088	Oct. 5	Slight.	Cons., brown.	.02	Very faint or none.	Distinctly musty.	35.80
14	13363	Nov. 21	Very slight.	Very slight.	.02	None.	Very faintly musty.	25.60
15	13537	Dec. 21	None.	Cons.	.01	Decidedly musty and disagreeable.	Distinctly musty.	27.60
16	Av.	....	....	....	.02	....	....	27.00
		1895.						
17	13643	Jan. 12	None.	Very slight.	.03	Very faint or none.	Faintly musty.	20.30
18	13722	Jan. 23	None.	None.	.02	Very faintly musty.	Distinctly musty.	20.70
19	13789	Feb. 9	Very slight.	None.	.03	Distinctly disagreeable and musty.	Distinctly musty.	21.60
20	14073	April 1	Distinct.	Slight.	.15	Offensive.	Offensive.	18.80
21	14131	April 10	Very slight.	Slight.	.10	Offensive.	Offensive.	17.70
22	14319	May 17	Slight.	Slight.	.05	Decidedly musty and disagreeable.	Offensive.	22.50
23	14463	June 11	Very slight.	Slight.	.07	Decidedly musty.	Decidedly musty and disagreeable.	27.30
24	14672	July 22	None.	Very slight.	.04	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	32.50
25	14804	Aug. 12	Slight.	Slight.	.40	Faintly musty.	Distinctly musty and disagreeable.	33.70
26	15199	Sept. 17	Slight.	Slight.	.02	None.	Distinctly musty.	32.90
27	15380	Oct. 16	Very slight.	Very slight.	.10	Distinctly unpleasant.	Distinctly unpleasant.	26.40
28	15513	Nov. 11	Distinct, white floc.	Slight, yellow floc.	.07	None.	Faintly musty.	26.60
29	15718	Dec. 10	None.	Very slight.	.04	None.	Very faintly musty.	21.60
30	15808	Dec. 26	None.	Very slight.	.01	None.	Faintly musty.	23.10
31	Av.	....	....	....	.09	....	....	25.24

The samples were collected from

Under-drain at the Framingham Filter-beds.

[Parts per 100,000.]

Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.	
Free.	Albu-minoid.		Nitrates.	Nitrites.				
.0400	.0020	3.76	0.9750	.0015	.1365	8.0	.0040	1
.0720	.0000	3.75	0.9000	.0020	.1335	5.4	.0000	2
.5440	.0076	3.74	0.7000	.0020	.1376	6.0	.0130	3
.0560	.0040	3.00	0.9000	.0030	.1040	4.7	.0050	4
.0600	.0050	3.17	1.1000	.0060	.1540	5.1	.0100	5
.0384	.0076	2.57	0.5250	.0020	.1659	4.2	.0050	6
.0344	.0092	3.55	1.1000	.0030	.0908	5.0	.0100	7
.0530	.0050	3.55	0.9500	.0010	.1189	5.6	.0000	8
.0336	.0056	3.58	1.2600	.0010	.0924	6.0	–	9
.0360	.0050	4.82	1.3750	.0040	.1270	8.2	.0140	10
.0202	.0078	4.60	1.6660	.0017	.0862	6.4	.0030	11
.0152	.0054	5.19	1.7500	.0010	.0770	6.9	.0030	12
.0112	.0084	5.00	1.7000	.0004	.1264	5.7	.0200	13
.0068	.0064	5.00	1.2000	.0002	.0858	6.4	.0010	14
.1040	.0190	4.64	1.0000	.0030	.1424	6.3	.0060	15
.0812	.0070	4.17	1.1959	.0019	.1155	6.1	.0070	16
.0192	.0072	3.58	0.8250	.0012	.1619	4.9	.0060	17
.0116	.0060	3.77	0.9500	.0005	.0711	4.4	.0020	18
.0784	.0112	4.40	0.7000	.0130	.1744	5.1	.0040	19
.5200	.0100	4.00	0.2000	.0050	.2556	4.3	.1000	20
.3520	.0150	3.65	0.3000	.0030	.2541	4.4	.1480	21
.2480	.0070	4.40	0.6800	.0040	.1501	5.3	.0240	22
.3520	.0070	3.95	0.8000	.0040	.1677	6.3	.0220	23
.3120	.0050	5.20	0.8750	.0100	.1575	8.7	.0140	24
.2400	.0100	5.10	1.0500	.0040	.5070	7.9	.1600	25
.1520	.0040	5.60	1.5000	.0060	.1186	7.0	.0080	26
.1120	.0150	5.15	0.9500	.0020	.1677	6.0	.0600	27
.1280	.0040	4.80	2.0000	.0040	.1170	6.3	.0880	28
.0636	.0074	3.79	0.9500	.0020	.0936	5.3	.0220	29
.0640	.0040	3.56	1.0000	.0020	.0693	5.4	.0140	30
.2145	.0084	4.47	0.9098	.0048	.1890	5.9	.0542	31

the under-drain at its outlet.

Chemical Examination of Water from a Spring near Bannister

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11596	Jan. 3	None.	None.	.00	None.	None.	16.60
2	11661	Jan. 18	None.	None.	.00	None.	None.	15.50
3	11774	Feb. 12	None.	None.	.00	None.	None.	16.40
4	11910	Mar. 15	None.	None.	.00	None.	None.	17.00
5	11952	Mar. 27	None.	None.	.00	None.	None.	15.90
6	12025	April 10	None.	Slight.	.00	V. faint or none.	None.	16.90
7	12110	April 26	None.	None.	.00	None.	None.	17.20
8	12196	May 10	None.	None.	.00	None.	None.	19.20
9	12350	June 11	None.	None.	.00	None.	None.	18.80
10	12513	July 10	None.	None.	.00	None.	None.	19.00
11	12712	Aug. 10	None.	V. slight.	.01	Distinctly unpleasant.	Distinctly disagreeable.	20.80
12	12955	Sept. 12	None.	None.	.02	None.	None.	20.80
13	13090	Oct. 5	None.	None.	.02	None.	None.	19.20
14	13364	Nov. 21	None.	None.	.00	None.	None.	18.50
15	13539	Dec. 21	None.	None.	.01	None.	None.	18.20
16	Av...	....	....	....	.01	....	....	18.37
		1895.						
17	13645	Jan. 12	None.	None.	.00	None.	None.	18.20
18	13724	Jan. 23	None.	None.	.00	None.	None.	18.50
19	13790	Feb. 9	None.	None.	.02	None.	None.	18.60
20	14074	April 1	None.	None.	.00	None.	None.	18.80
21	14132	April 10	None.	None.	.00	None.	None.	18.40
22	14321	May 17	None.	V. slight.	.00	None.	None.	15.60
23	14465	June 11	None.	None.	.00	None.	None.	17.70
24	14674	July 22	None.	None.	.00	None.	None.	19.70
25	14806	Aug. 12	None.	None.	.00	None.	None.	22.80
26	15201	Sept. 17	None.	None.	.00	None.	None.	20.80
27	15382	Oct. 16	None.	V. slight.	.00	None.	None.	19.10
28	15515	Nov. 12	None.	None.	.00	None.	None.	18.50
29	15716	Dec. 10	V. slight.	V. slight.	.00	None.	None.	14.70
30	15810	Dec. 26	None.	None.	.00	None.	None.	17.60
31	Av...	....	....	....	.00	....	....	18.71

Brook which receives Effluent from the Framingham Filter-beds.

[Parts per 100,000.]

Ammonia.			Nitrogen as					
Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.	
.0000	.0006	2.97	0.5250	.0000	.0195	4.3	.0000	1
.0000	.0000	2.92	0.7000	.0000	.0000	4.2	.0000	2
.0000	.0028	3.18	0.6500	.0000	.0240	4.6	.0000	3
.0004	.0032	2.81	0.8000	.0000	.0184	4.2	.0050	4
.0000	.0014	2.80	0.7000	.0000	.0423	3.8	.0000	5
.0000	.0016	3.02	0.7500	.0001	.0434	4.3	.0050	6
.0012	.0038	3.23	0.9000	.0000	.0261	4.0	.0000	7
.0000	.0044	3.18	0.9000	.0000	.0558	4.3	.0000	8
.0000	.0024	3.18	0.7500	.0000	.0293	3.8	–	9
.0004	.0010	3.19	0.4000	.0000	.0431	4.6	.0050	10
.0024	.0056	3.12	1.0000	.0000	.0000	4.0	.0000	11
.0000	.0008	3.02	1.2500	.0000	.0154	4.6	.0000	12
.0000	.0018	3.01	1.0000	.0000	.0237	4.6	.0220	13
.0012	.0016	3.60	1.1250	.0000	.0273	4.6	.0010	14
.0004	.0018	3.21	0.7200	.0000	.0000	5.0	.0000	15
.0004	.0023	3.13	0.8319	.0000	.0244	4.4	.0030	16
.0004	.0022	3.20	0.8000	.0000	.0395	5.0	.0010	17
.0000	.0030	3.42	1.0750	.0000	.0118	5.7	.0000	18
.0000	.0030	3.05	0.9500	.0000	.0400	5.3	.0000	19
.0000	.0016	3.35	1.0500	.0000	.0000	4.9	.0030	20
.0000	.0008	3.30	0.5250	.0000	.0500	4.7	.0010	21
.0000	.0014	2.60	0.6000	.0000	.0197	4.0	.0000	22
.0000	.0008	3.00	0.7250	.0001	.0507	3.9	.0000	23
.0000	.0010	3.80	0.3650	.0000	.0300	4.7	.0020	24
.0000	.0010	3.76	0.6250	.0000	.0702	5.1	.0000	25
.0000	.0022	3.60	0.8750	.0000	.0117	4.4	.0000	26
.0002	.0030	4.00	0.6500	.0000	.0374	5.0	.0000	27
.0000	.0022	3.30	1.2000	.0000	.0273	4.3	.0000	28
.0006	.0022	2.05	0.4500	.0000	.0390	3.6	.0050	29
.0000	.0010	3.37	1.4000	.0000	.0616	4.0	.0020	30
.0001	.0018	3.31	0.7856	.0000	.0344	4.6	.0008	31

Chemical Examination of Water from Bannister Brook below the Framingham Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1895.														
14461	June 11	V. slight.	Slight.	1.60	8.65	3.70	.0036	.0332	.0322	.0010	1.25	.0480	.0011	1.2090	2.3
14669	July 22	Slight.	Cons., brown.	1.30	10.40	4.00	.0066	.0468	.0362	.0106	1.57	.1100	.0011	1.2012	2.7
14802	Aug. 12	Slight.	Slight, yellow.	1.70	10.00	4.60	.0100	.0528	.0484	.0044	1.20	.0200	.0003	2.2620	3.1
15197	Sept. 17	Slight.	Slight.	0.65	11.25	3.00	.0040	.0194	.0180	.0014	2.12	.0630	.0010	0.6513	3.1
Av.	....	....	....	1.31	10.07	3.82	.0060	.0380	.0337	.0043	1.53	.0602	.0009	1.3309	2.8

Odor, distinctly vegetable and mouldy. —— The samples were collected from the brook, at the first road crossing below the sewage field.

Sewage Disposal at Gardner.

The Gardner sewerage system was put in operation about Aug. 1, 1891. At the end of 1895 there were 254 connections with the sewers. The population of the town in 1895 was 9,182. With the exception of roof water used for flushing purposes from a limited number of buildings at the upper ends of the sewers, surface water is excluded. Care was also taken during the construction of the system to exclude ground water by making tight joints between the sewer pipes; but no under-drains were placed beneath the sewers, and there is a considerable quantity of ground water mixed with the sewage. The quantity of sewage is not definitely known, but it is probably not far from 250,000 gallons per day in dry weather.

The tract of land purchased by the town for the disposal of sewage contains 16.9 acres. Much of the material upon this tract was found to be too fine for the filtration of sewage, and as a result the filter-beds are almost wholly artificial, being formed of the porous sand and gravel from a ridge upon this tract. There are 12 thoroughly under-drained filter-beds, having a total area of 1.4 acres; two supplementary beds, which are less porous and not under-drained, having a total area of 0.37 acre; and two other small, under-drained beds, containing together 0.14 of an acre. One of the last beds is

used to receive the sludge from the sludge tank and the other was constructed to receive the discharge from a blow-off located at the lowest point in the inverted syphon which conveys the sewage from the town across the valley of Pond Brook to the filter-beds. This bed, however, has not been used for several years, as it has been found that if clogging occurs in the syphon the sewage backs up in the pipe until sufficient head is obtained to remove the obstruction.

The material of the filter-beds has an effective size of 0.10 to 0.24 millimeters, which is somewhat coarser than that at Marlborough but much finer than that at Framingham. Under-drains beneath the beds are generally 20 feet apart, and at a depth of 4 to 5 feet below the surface of the beds. The sewage when it reaches the disposal area first passes through duplicate separating tanks, having a combined capacity of about 10,000 gallons, and overflows through wooden troughs upon the disposal area, as described in the annual report of the Board for 1892, page 580.

The operation of these filter-beds in winter is very different from that in warm weather. During the warmer portions of the year it has been the general custom to apply the sewage to the beds in rotation once in two days, the amount applied depending upon the character of the material of the bed. The deposit which forms upon the surface of the filter is removed, and the surface of the sand raked to a depth of 2 or 3 inches, about once in ten days or two weeks. By this method of operation good purification has been obtained during the warmer portion of the year. In winter weather, when the amount of sewage is greater and it is impossible to remove the solid matter from the beds, the filters become greatly overtaxed, and a short time after severe winter weather sets in all of the beds are covered with the sewage and much of the time a large part of it overflows into the adjoining brook. When the warmer weather comes the surface of the beds becomes uncovered, the sludge which has accumulated during the winter is scraped off and the quality of the effluent rapidly improves.

The area of the filter-beds is inadequate for purification of the sewage of the town, and it will be necessary to prepare a larger number of beds in order to prevent unpurified or partially purified sewage from entering the brook.

During the last two winters the surfaces of the filters have been furrowed, and the results obtained have been somewhat better than in previous years, although it appears that the night flow

during the winter finds its way into the brook without purification, and during the coldest weather much of the flow during the day cannot be taken care of by the filters.

During 1894 it was found that just beneath the surface the material had become very compact, and to remedy this the greater part of the filter area was worked over for a depth of 8 or 10 inches. Many small stones were met in this treatment, and holes several feet deep were dug in the filters, in which the stones were buried. As the few inches of material placed over the stones washed away to a certain extent, this process was an unfortunate one, because it gave an

Chemical Examination of

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1894.									
1	11625	Jan. 10	Decided, milky.	Cons., thick.	.60	26.60	20.20	6.40	15.20	9.00	6.20
2	11751	Feb. 13	Distinct.	Cons., gray.	.10	7.90	7.30	0.60	2.10	1.70	0.40
3	11811	Feb. 26	Decided.	Heavy, gray.	.40	22.80	18.20	4.60	12.20	8.30	3.90
4	11881	Mar. 13	Decided.	Heavy, gray.	.40*	23.30	18.00	5.30	13.20	8.70	4.50
5	11953	Mar. 27	Decided.	Heavy, gray.	.50	19.00	14.40	4.60	6.60	2.60	4.00
6	12030	April 11	Decided, milky.	Heavy, gray.	.40	26.00	15.60	10.40	13.00	4.40	8.60
7	12102	April 25	Decided, milky.	Heavy, gray.	.25	20.00	15.00	5.00	8.80	5.20	3.60
8	12182	May 9	Decided.	Heavy, gray.	.60	18.80	15.60	3.20	7.00	5.40	1.60
9	12358	June 12	Decided.	Cons., white.	.60	27.40	13.60	13.80	15.80	4.60	11.20
10	12508	July 10	Decided, milky.	Cons., white.	.60	24.40	17.00	7.40	12.40	8.00	4.40
11	12682	Aug. 8	Thick.	Heavy, white.	.50	34.00	15.60	18.40	22.40	6.00	16.40
12	12944	Sept. 12	Thick.	Heavy, dirty.	.60	38.60	20.00	18.60	24.80	9.60	15.20
13	13119	Oct. 10	Decided, milky.	Heavy, gray.	.40	39.00	14.80	24.20	15.20	4.90	10.30
14	13297	Nov. 13	Decided.	Cons., gray.	*	29.40	21.40	8.00	18.90	12.10	6.80
15	13471	Dec. 11	Decided.	Heavy, gray.	.60	26.30	17.60	8.70	15.50	7.70	7.80
16	Av.	....	....	....	-	27.00	16.67	10.30	14.60	6.90	7.70
		1895.									
17	13637	Jan. 9	Decided, milky.	Cons., white.	.60	25.90	17.10	8.80	16.80	9.40	7.40
18	13783	Feb. 7	Thick.	Heavy, light colored.	.90	39.10	27.10	12.00	26.90	16.60	10.30
19	13817	Feb. 13	Decided.	Heavy, gray.	.50	27.70	21.30	6.40	13.00	8.80	4.20
20	13894	Feb. 27	Thick.	Heavy, gray.	.60	46.20	23.90	22.30	32.50	13.50	19.00
21	13976	Mar. 13	Decided.	Heavy, gray.	.80	27.90	23.50	4.40	15.70	11.60	4.10
22	14043	Mar. 26	Decided.	Heavy, light colored.	.50	26.70	19.60	7.10	13.70	8.60	5.10
23	14126	April 10	Decided.	Cons , gray.	.20	24.40	18.90	5.50	10.90	7.00	3.90
24	14297	May 14	Decided.	Heavy.	.40	39.40	18.20	21.20	22.20	6.60	15.60
25	14468	June 12	Decided, milky.	Heavy, light colored.	.50	29.90	17.90	12.00	16.40	7.30	9.10
26	14644	July 17	Decided.	Heavy, gray.	.40	33.40	18.20	15.20	23.00	8.40	14.60
27	14839	Aug. 14	Thick, white.	Heavy, light colored.	.60	38.20	20.60	17.60	21.00	6.80	14.20
28	15160	Sept. 12	Thick.	Heavy, light colored.	.70	39.50	17.00	22.50	20.70	6.10	14.60
29	15390	Oct. 16	Thick, white.	Heavy, white.	.22	26.40	17.40	9.00	13.70	6.20	7.50
30	15546	Nov. 13	Decided, white.	Heavy.	.70	35.00	23.00	12.00	20.80	11.60	9.20
31	15723	Dec. 11	Decided.	Heavy, gray.	.60	25.40	20.80	4.60	13.20	10.40	2.80
		1896.									
32	15822	Jan. 1	Decided, milky.	Cons.	.33	22.60	18.40	4.20	9.20	6.60	2.60
33	Av.	....	....	....	.51	32.25	19.75	12.49	18.27	7.73	9.70

* Too turbid to determine.

opportunity for some of the sewage to reach the effluent pipe in a less purified state than should be the case.

The average analyses, as given in the following tables, indicate that of the sewage filtered, about 89 per cent. of the organic matter, as represented by the albuminoid ammonia, was removed by filtration during 1894, and about 90 per cent. during 1895. For the results of chemical and bacterial analyses, showing the variations at different hours of the day in composition of the summer sewage and measurements of its quantity, a reference is made to page 468 of the annual report for 1894.

Sewage from Gardner.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.		Iron.			
	Albuminoid.											
Free.	Total.	Dis-solved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.	Hardness.	
1.7600	0.3080	0.1980	0.1100	2.79	.0100	.0140	3.9000	2.8860	.0600	.0360	3.0	1
0.4720	0.0520	0.0420	0.0100	1.80	.0400	.0050	0.4624	0.4280	.0230	.0100	1.7	2
1.4400	0.0406	0.0286	0.0120	2.41	.0200	.0130	3.1360	2.7200	.0600	.0400	3.1	3
1.2000	0.3160	0.1760	0.1400	2.00	.0680	.0140	3.4160	2.2800	.0460	.0280	3.1	4
1.1200	0.3240	0.2640	0.0600	2.40	.1560	.0400	3.0030	2.2330	.0740	.0500	3.2	5
1.1200	0.4460	0.2840	0.1620	2.42	.0400	.0080	4.0290	2.7255	.1300	.0400	3.9	6
0.9520	0.2540	0.1300	0.1240	2.41	.1250	.0100	2.1330	1.4220	.0560	.0200	3.4	7
1.8560	0.3640	0.2000	0.1640	2.56	.0050	.0000	2.5830	2.0910	.0800	.0240	3.0	8
2.0800	0.4640	0.1980	0.2660	2.00	.0000	.0000	3.5574	1.4476	-	-	3.5	9
1.9840	0.5200	0.3100	0.2100	2.97	.0000	.0000	-	1.7248	-	-	2.9	10
1.0880	0.3860	0.1480	0.2380	2.20	.0000	.0000	3.2340	1.7941	-	-	4.6	11
2.0160	0.4560	0.2140	0.2420	3.01	.0000	.0000	2.5564	2.0328	.0500	.0200	2.3	12
1.9600	0.4140	0.1620	0.2520	2.75	.0000	.0000	3.8000	1.2768	.4700	.0620	2.7	13
0.9920	0,2640	0.1500	0.1140	2.20	.0050	.0140	4.7190	3.8610	.0660	.0400	2.6	14
1.9680	0.5420	0.3820	0.1600	2.38	.0050	.0020	3.5574	2.5564	.0400	.0260	2.9	15
1.5713	0.3695	0.2020	0.1675	2.47	.0208	.0063	3.2724	2.1312	.1067	.0336	3.1	16
0.9920	0.3160	0.1820	0.1340	2.12	.0120	.0180	4.3290	2.9640	.0520	.0300	2.6	17
1.6640	2.1120	0.9600	1.1520	2.05	.0000	.0200	5.2930	3.5945	.0500	.0250	3.9	18
1.5200	0.4800	0.3700	0.1100	2.80	.0050	.0080	3.7600	2.1760	.0400	.0200	2.3	19
2.5920	0.6140	0.3960	0.2180	2.40	.0000	.0000	6.7545	4.4082	.0820	.0320	3.8	20
1.5360	0.6460	0.3240	0.3220	2.60	.0050	.0200	4.7360	2.6800	.0450	.0420	3.2	21
1.2640	0.4200	0.2200	0.2000	2.30	.0000	.0400	2.9260	1.6170	.0700	.0350	3.4	22
0.7680	0.2280	0.1260	0.1020	2.75	.1200	.0340	2.1406	1.5400	.0950	.0240	3.9	23
1.4400	0.4920	0.1840	0.3080	1.95	.0050	.0000	5.5695	1.7380	.1800	.0660	3.1	24
1.3440	0.4440	0.1900	0.2540	3.05	.0000	.0000	3.3930	1.5990	.0600	.0330	3.2	25
2.1120	0.6440	0.2300	0.4140	2.70	.0000	.0000	3.2625	2.0625	.0800	.0540	3.4	26
2.2400	0.7140	0.3100	0.4040	3.60	.0030	.0000	4.9140	2.3400	.1240	.0740	5.1	27
1.6000	0.6900	0.3200	0.3700	3.00	.0000	.0000	6.8250	2.4180	-	-	3.8	28
0.9920	0.3460	0.1200	0.2260	3.00	.0030	.0000	4.2276	2.1294	.0800	.0380	4.3	29
2.6880	0.6460	0.2760	0.3700	3.30	.6030	.0000	4.8360	2.0436	.1040	.0520	3.5	30
1.8800	0.4120	0.3080	0.1040	2.93	.0450	.0250	3.6036	2.6910	.0340	.0160	3.8	31
1.8240	0.0240	0.0170	0.0070	2.40	.1860	.0400	1.8634	1.2320	.0400	.0240	4.9	32
1.6517	0.5597	0.2621	0.2976	2.76	.0225	.0100	4.3167	2.2126	.0775	.0377	3.8	33

Odor, offensive. —— The sewage was collected as it flowed upon the beds.

Chemical Examination of Effluent from the

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11626	Jan. 11	Decided, milky.	Slight.	0.20	Offensive.	Offensive.	11.70
2	11752	Feb. 13	Distinct.	Very slight, white.	0.30	Offensive.	Offensive.	11.90
3	11812	Feb. 26	Very slight, milky.	Very slight.	0.10	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	11.80
4	11882	Mar. 13	Distinct.	Very slight.	0.20	Offensive.	Offensive.	13.50
5	11954	Mar. 27	Slight, milky.	Slight.	0.23	Offensive.	Offensive.	22.40
6	12031	April 11	Distinct, milky.	Very slight.	0.10	Decidedly musty.	Offensive.	14.10
7	12103	April 25	Distinct, milky.	Cons. floc.	0.08	Decidedly musty.	Offensive.	20.50
8	12183	May 9	Slight, milky.	Slight.	0.10	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	16.40
9	12359	June 12	Slight, milky.	Very slight.	0.10	Decidedly musty.	Distinctly mouldy.	24.20
10	12509	July 10	Distinct, milky.	Slight.	0.05	Decidedly musty.	Decidedly musty.	22.60
11	12683	Aug. 8	Slight, milky.	Slight, white.	0.07	Distinctly musty and unpleasant.	Decidedly musty.	24.70
12	12945	Sept. 12	Distinct, milky.	Slight, white.	0.10	Decidedly disagreeable.	Distinctly disagreeable.	13.30
13	13120	Oct. 10	Distinct, milky.	Cons., white.	0.08	Offensive.	Offensive.	18.00
14	13298	Nov. 13	Distinct, milky.	Slight, white.	0.08	Offensive.	Decidedly musty.	14.30
15	13472	Dec. 11	Very slight, milky.	Very slight.	0.23	Decidedly musty and disagreeable.	Offensive.	12.10
16	Av.	....	....	....	0.13	....	....	17.03
		1895.						
17	13638	Jan. 9	Distinct, milky.	Slight.	0.30	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	12.50
18	13784	Feb. 7	Decided, white.	Cons., light colored.	0.38	Distinctly musty and disagreeable.	Decidedly musty and offensive.	12.60
19	13818	Feb. 13	Decided, milky.	Cons., gray.	0.60	Offensive.	Offensive.	13.30
20	13895	Feb. 27	Decided.	Cons., gray.	1.05	Offensive.	Offensive.	17.00
21	13977	Mar. 13	Decided.	Cons.	1.00	Offensive.	Offensive.	12.60
22	14044	Mar. 26	Decided.	Slight.	1.20	Offensive.	Offensive.	11.50
23	14127	April 10	Decided.	Cons., rusty.	1.25	Offensive.	Offensive.	14.10
24	14298	May 14	Distinct, milky.	Slight.	0.12	Decidedly musty.	Decidedly musty and disagreeable.	29.70
25	14469	June 12	Distinct, milky.	Slight.	0.07	Offensive.	Offensive.	20.90
26	14645	July 17	Distinct.	Cons.	0.05	Offensive.	Offensive.	19.40
27	14840	Aug. 14	Slight, milky.	Slight.	0.10	Distinctly musty and disagreeable.	Decidedly musty.	20.40
28	15161	Sept. 12	Slight.	Slight.	0.08	Distinctly unpleasant.	Decidedly musty.	24.20
29	15391	Oct. 16	Distinct, white.	Cons., white.	0.10	Offensive.	Offensive.	16.50
30	15547	Nov. 13	Slight, milky.	Slight.	0.15	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	17.40
31	15724	Dec. 11	Distinct.	Very slight.	0.30	Decidedly disagreeable.	Decidedly musty.	20.00
		1896.						
32	15823	Jan. 1	Slight, milky.	Slight.	0.27	Offensive.	Distinctly musty and disagreeable.	17.80
33	Av.	....	....	....	0.37	....	....	18.44

The samples were collected from the main under-

Main Under-drain of the Gardner Filter-beds.

[Parts per 100,000.]

Ammonia.			Nitrogen as					
Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.	
0.8800	.0550	2.40	0.0200	.0015	0.5928	3.0	.0250	1
0.9280	.0570	2.49	0.1800	.0020	0.5760	2.3	.0680	2
1.0000	.0480	2.64	0.1000	.0030	0.5280	2.7	.0170	3
0.7360	.0530	1.81	0.3000	.0400	0.5656	3.5	.0380	4
1.0400	.0570	1.82	2.0000	.1600	0.8085	5.8	.0400	5
0.4000	.0390	2.17	0.3900	.0110	0.4700	2.9	.0240	6
0.3040	.0510	2.24	1.2500	.0200	0.3950	6.1	.0180	7
0.2120	.0370	1.83	0.6500	.1000	0.4936	4.4	.0200	8
0.1440	.0230	2.39	1.1250	.0030	0.2487	5.0	-	9
0.1200	.0260	2.40	1.5000	.0150	0.3041	5.4	.0260	10
0.0600	.0210	1.60	2.5000	.0004	0.2464	6.9	.0080	11
0.1840	.0380	1.66	0.6000	.0230	0.4312	2.6	.0500	12
0.1560	.0370	1.65	1.8750	.0200	0.3040	5.6	.0160	13
0.2440	.0420	2.70	0.5800	.0150	0.4430	3.1	.0080	14
0.8000	.0520	2.24	0.2800	.0080	0.4297	2.6	.0070	15
0.4170	.0403	2.12	0.9367	.0253	0.4304	4.2	.0239	16
0.9440	.0580	2.00	0.1400	.0020	0.6240	2.7	.0200	17
0.9920	.0840	1.94	0.0650	.0020	0.7268	2.7	.0700	18
0.2960	.1020	2.50	0.1000	.0010	0.8040	2.5	.1100	19
1.8560	.1580	2.60	0.0150	.0020	1.1889	3.8	.3250	20
1.6000	.1180	2.25	0.0350	.0020	1.1160	2.7	.3250	21
1.0560	.1160	2.15	0.0350	.0050	0.7931	2.7	.2600	22
0.1440	.0900	2.40	0.0900	.0060	0.8816	2.6	.4900	23
0.2880	.0260	2.00	2.4500	.0030	0.3278	8.3	.0370	24
0.1960	.0330	2.05	0.9500	.0130	0.3916	4.3	.2600	25
0.2200	.0330	2.80	1.0750	.0040	0.3525	6.6	.0520	26
0.2120	.0320	2.90	1.1000	.0040	0.3744	4.7	.0430	27
0.5040	.0440	3.80	1.3750	.0100	1.0920	4.3	.0880	28
0.3600	.0190	3.05	0.6500	.0130	0.3136	3.6	.0200	29
0.0320	.0350	3.15	0.4500	.0200	0.4173	3.6	.0380	30
0.7760	.0260	3.00	0.8000	.0750	0.5460	4.9	.0660	31
0.6400	.0380	2.30	0.6500	.0500	0.4605	3.9	.0530	32
0.5030	.0552	2.63	0.7550	.0119	0.6039	4.2	.1369	33

drain at the point where it discharges into the brook.

Chemical Examination of Water from Pond Brook above the Gardner Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14470	June 12	Slight, milky.	Slight.	.30	42.00	15.60	.0248	.0328	.0264	.0064	9.40	.0650	.0140	0.5054	14.4
14646	July 17	Slight.	Slight.	.28	31.60	11.10	.0080	.0220	.0204	.0016	7.40	.2100	.0042	0.3225	13.2
14841	Aug. 14	Slight, milky.	V. slight.	.25	29.10	3.90	.0056	.0216	.0192	.0024	7.00	.0800	.0022	0.4524	10.9
15162	Sept. 12	Decided, milky.	Cons., earthy.	.70	27.50	-	.0720	.0500	.0280	.0220	6.00	.0250	.0012	1.1310	8.4
Av.	....	....	....	.38	32.55	10.20	.0276	.0316	.0235	.0081	7.45	.0950	.0054	0.6028	11.7

Iron, .1100. Odor, musty or offensive.—— The samples were collected from the brook, above the point where it is crossed by the main sewer leading to the filter-beds.

Chemical Examination of Water from Pond Brook below the Gardner Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
	1895.														
14471	June 12	Slight, milky.	Slight.	.25	31.00	14.30	.0368	.0332	.0280	.0052	7.00	.2500	.0140	0.4797	10.6
14647	July 17	V. slight.	Slight.	.25	26.60	11.90	.0192	.0212	.0200	.0012	6.20	.0850	.0025	0.4237	10.0
14842	Aug. 14	V. slight.	V. slight.	.20	25.30	4.90	.0192	.0236	.0204	.0032	5.60	.1840	.0050	0.4368	8.7
15163	Sept. 12	Decided, milky.	Slight, earthy.	.70	25.20	-	.0960	.0300	.0240	.0060	5.65	.0900	.0060	1.2480	7.7
Av.	....	....	....	.35	27.02	10.37	.0428	.0270	.0231	.0039	6.11	.1522	.0069	0.6970	9.2

Iron, .0857. Odor, distinctly musty or unpleasant.—— The samples were collected from the brook, below the filter-beds and below the point where effluent from the filter-beds enters the stream.

Sewage Disposal of Marlborough.

The sewerage system of the city of Marlborough (population in 1895, 14,977) was completed late in 1891, and at the end of 1895 there were about 1,252 connections, including all of the larger buildings, such as hotels, factories, etc.; the total length of sewers was

22.07 miles. The so-called "separate system" was adopted, but no under-drains were laid beneath the sewers, and a large amount of ground water enters them at certain seasons of the year.

As the sewage arrives at the disposal field it passes through duplicate separating tanks and screens before passing into the distributing pipes. Each tank is about 25 feet long, 6½ feet wide and 6 feet deep. The screens are of wire, and have a 1-inch mesh. The sludge which is deposited in the tanks flows by gravity to beds prepared for this purpose.

The total area of the tract bought by the city is 62.7 acres. Upon this tract 13 sewage beds with a total area of 9.6 acres and 6 sludge beds with a total area of 1.7 acres have been prepared for the disposal of the sewage and sludge. The material of the beds is finer than that of Framingham or Gardner, and has an effective size of 0.12 to 0.14 millimeters. The area has a moderate slope toward a small brook, and is from 7 to 22 feet above it. The beds are thoroughly under-drained by means of parallel lines of pipe, 50 feet apart and about 6 feet beneath the surface. All these drains discharge into the brook before mentioned.

The sewage is ordinary city sewage, varying in strength from time to time with the amount of ground water which enters the sewers. The quantity of sewage is not known, but the dry weather flow is probably in the neighborhood of 500,000 gallons per day.

For the results of chemical and bacterial analyses of hourly samples, showing the variation in the summer sewage as it flowed into the settling tanks, reference is made to page 467 of the annual report for 1894 and page 455 of this volume. In the same tables hourly measurements of flow will also be found. Each bed generally receives the sewage for twenty-four hours, unless the quantity of sewage is so great as to cause it to overflow its banks; and the sewage disappears from the surface in from one to ten days after receiving the dose.

The surfaces are ploughed and harrowed about once in three weeks, the sludge being raked from the surface before the bed is ploughed. After this treatment the sewage disappears from the bed rapidly, the length of time taken for it to pass through the filter increasing with each application of sewage.

In the fall the surfaces of the beds are furrowed with a disc harrow and in the winter the sewage is applied to the beds for not more than half a day at a time. The capacity of the field, however,

is insufficient for the flow during wet weather. At such times a portion of the sewage flows directly into the brook.

The separating tanks are emptied once in two weeks, and the sludge, after being dried on the beds prepared for the purpose, is carted away by the farmers for use upon the land as a fertilizer.

It has not been the custom to employ a man constantly in caring for the beds, as in the cases of Brockton, Framingham and Gardner, but to employ a man living in the neighborhood to attend to changing the flow of sewage from bed to bed and to remove the scum from the surface of the beds, paying him by the hour for the

Chemical Examination of

[Parts per 100,000.]

			Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
	Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1894.									
1	11619	Jan. 9	Decided, thick.	Heavy, dark.	0.60	56.80	33.80	23.00	27.20	8.80	18.40
2	11768	Feb. 14	Thick.	Heavy.	0.70	57.60	34.20	23.40	28.20	9.00	19.20
3	11814	Feb. 27	Thick.	Heavy, gray.	1.50	46.40	32.80	13.60	20.40	10.00	10.40
4	11886	Mar. 13	Decided.	Cons., gray.	0.30	32.40	26.60	5.80	12.00	6.80	5.20
5	11960	Mar. 27	Decided.	Heavy, gray.	0.50	37.80	30.00	7.80	10.00	4.20	5.80
6	12038	April 14	Decided.	Heavy, gray.	0.33	40.00	25.00	15.00	10.20	7.00	3.20
7	12111	April 25	Decided.	Heavy, gray.	0.60	32.60	24.80	7.80	11.60	5.20	6.40
8	12189	May 9	Decided, milky.	Heavy, gray.	0.60	37.80	29.40	8.40	15.20	8.80	6.40
9	12362	June 11	Thick.	Heavy, dark.	0.60	74.20	57.20	17.00	24.20	14.40	9.80
10	12522	July 10	Thick, dark.	Heavy, black.	1.50	101.40	53.40	48.00	54.40	18.00	36.40
11	12720	Aug. 9	Thick.	Heavy, dark.	*	57.40	33.60	23.80	28.60	6.40	22.20
12	12946	Sept. 12	Thick.	V. heavy, dark.	0.70	70.60	28.40	42.20	47.80	11.60	36.20
13	13126	Oct. 12	Decided.	Heavy, gray.	1.50	88.40	29.00	59.40	56.20	7.20	49.00
14	13316	Nov. 14	Decided.	Heavy, gray.	0.80	47.40	31.80	15.60	19.20	8.00	11.20
15	13481	Dec. 13	Decided.	Heavy, brown.	2.00	75.90	40.80	35.10	35.80	8.90	26.90
16	Av..	....	....	....	-	61.11	35.34	25.77	29.57	9.43	20.13
		1895.									
17	13649	Jan. 11	Decided.	Heavy, gray.	0.60	37.10	25.50	11.60	13.80	4.10	9.70
18	13715	Jan. 23	Decided.	Heavy, gray.	0.50	40.10	29.30	10.80	16.70	7.90	8.80
19	13857	Feb. 18	Thick.	Heavy, brown.	-	93.10	47.80	45.30	57.40	18.90	38.50
20	13901	Feb. 28	Decided.	Cons., dirty.	0.18	42.00	23.30	18.70	22.60	5.40	17.20
21	13984	Mar. 15	Decided.	Heavy, gray.	0.20	24.50	21.10	3.40	7.50	5.40	2.10
22	14049	Mar. 26	Thick.	Heavy, white.	0.50	47.80	27.80	20.00	22.40	6.70	15.70
23	14135	April 10	Decided.	Cons.	0.40	35.50	26.20	9.30	13.40	7.50	5.90
24	14364	May 22	Decided.	Heavy.	0.90	49.40	35.80	13.60	22.80	12.00	10.80
25	14475	June 17	Distinct.	Slight.	0.55	24.60	23.00	1.60	4.90	4.30	0.60
26	14649	July 17	Decided.	Cons., gray.	0.23	27.80	22.20	5.60	10.20	5.60	4.60
27	14813	Aug. 11	Decided.	V. heavy, black.	0.40	78.60	23.60	55.00	31.20	5.00	26.20
28	15215	Sept. 17	Thick.	Heavy, dark.	-	60.70	45.50	15.20	26.70	14.30	12.40
29	15397	Oct. 16	Decided, milky.	Heavy, grayish.	0.40	37.40	28.00	9.40	13.50	6.10	7.40
30	15551	Nov. 14	Distinct.	Cons., white.	0.10	23.00	22.20	0.80	8.00	7.80	0.20
31	15727	Dec. 11	Decided.	Heavy.	0.60	32.60	26.00	6.60	13.80	9.20	4.60
32	15811	Dec. 26	Distinct.	Cons.	0.30	29.80	22.80	7.00	10.00	4.40	5.60
33	Av..	....	....	....	-	42.54	28.19	14.35	17.73	7.80	9.93

* Too turbid to determine.

time spent on the work. The cost of all work done on the beds during 1895 amounted to about $1,000.

At times there has been considerable odor from the sludge beds and around the outlet of the carriers, but this has been overcome somewhat by the use of lime. The average analyses for the year 1894, as presented in the following tables, indicate that about 95 per cent. of the organic matter, as represented by the albuminoid ammonia, was removed from that portion of the sewage which was applied to the beds during that year, and during 1895 the percentage of organic matter removed was about 93.

Sewage from Marlborough.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.		Iron.			
	Albuminoid.											
Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.	Hardness.	
3.5200	0.9080	.2640	0.6440	6.62	.0000	.0800	7.0590	3.3150	.2000	.0560	7.4	1
3.5200	0.7720	.3020	0.4700	7.57	.0000	.0000	5.1840	2.5440	.2000	.0800	6.6	2
1.9200	0.5800	.2560	0.3240	5.60	.0000	.0000	4.9200	3.0000	.2640	.0800	6.3	3
1.0400	0.2860	.1320	0.1540	4.18	.3500	.0600	3.6800	2.0640	.1400	.0400	7.4	4
2.0800	0.4780	.2160	0.2620	5.98	.1360	.1800	3.3495	1.5400	.1300	.0300	7.3	5
0.9120	0.2180	.0820	0.1360	4.38	.2500	.0800	3.2400	1.1600	.4700	.0720	7.4	6
1.2480	0.4840	.1640	0.3200	5.19	.0000	.0000	1.9750	1.2087	.1560	.0600	6.9	7
1.6320	0.2920	.2240	0.0680	5.64	.0000	.0000	3.2800	2.2140	.1600	.0840	7.1	8
3.6000	0.5600	.2480	0.3120	2.38	.0000	.0000	4.7509	2.7335	–	–	7.7	9
9.6000	1.5800	.5100	1.0700	12.30	.0000	.0000	–	3.8654	–	–	8.9	10
3.2000	0.9000	.3000	0.6000	8.00	.0000	.0000	5.2745	1.6170	–	–	6.3	11
2.2400	0.5200	.1740	0.3460	3.97	.0000	.0000	2.3408	1.8172	.1800	.0900	4.2	12
4.0320	1.3580	.4200	0.9380	6.40	.0000	.0000	8.7400	2.9260	.2400	.0500	9.3	13
2.6880	0.4700	.2180	0.2520	6.90	.0000	.0000	4.8750	1.9890	.2200	.0700	8.6	14
3.1360	1.1060	.3060	0.8000	11.44	.0300	.0800	7.6615	2.5410	.1950	.0450	8.1	15
3.2507	0.7586	.2700	0.4886	6.68	.0332	.0267	5.0142	2.3980	.2083	.0640	7.4	16
1.8560	0.4420	.1720	0.2700	6.11	.0030	.1000	3.6735	1.3430	.0880	.0270	7.4	17
2.0800	0.4480	.1520	0.2960	5.66	.0000	.0850	3.2390	1.6195	.1050	.0300	8.1	18
4.8800	1.5800	.6600	0.9200	7.15	.0000	.0000	11.1540	5.0310	.2200	.0740	7.1	19
0.3280	0.2940	.0400	0.2540	3.80	.2750	.0600	2.6860	1.2008	.1420	.0650	10.6	20
0.8480	0.1320	.0400	0.0920	3.35	.4750	.0370	1.3825	0.7742	.0570	.0200	7.0	21
1.7600	0.5240	.2280	0.2960	5.00	.0000	.0000	4.3890	1.7325	.0900	.0400	7.0	22
1.0400	0.3080	.1160	0.1920	4.60	.1200	.3000	2.5025	1.5246	.1200	.0370	7.3	23
2.4000	0.5680	.2620	0.3060	7.35	.0050	.0000	5.5860	2.7132	.1500	.0800	7.9	24
4.8640	0.1440	.1020	0.0420	5.00	.0000	.0000	1.4820	1.0920	.1880	.1350	6.7	25
0.3920	0.1160	.0600	0.0560	4.00	.0800	.0260	0.5250	0.3375	.0900	.0540	8.0	26
0.6400	0.5800	.0760	0.5040	3.60	.0070	.0000	5.3040	1.4040	.3600	–	9.4	27
4.8640	0.6160	.2880	0.3280	9.65	.0000	.0000	6.7860	3.9390	.2850	.0750	5.4	28
0.9920	0.4020	.1480	0.2540	5.40	.0000	.0000	3.1590	1.8720	.1220	.0550	8.4	29
0.2560	0.0420	.0100	0.0320	3.45	.4250	.0400	0.8970	0.6630	.0540	.0260	8.4	30
2.0480	0.3980	.1740	0.1240	4.60	.0000	.0000	2.9434	1.1700	–	–	7.8	31
1.7600	0.3460	.1220	0.2240	4.22	.0000	.0000	1.3090	0.9240	.1100	.0320	7.9	32
1.9357	0.4048	.1547	0.2501	5.25	.0845	.0422	4.7519	1.7036	.1336	.0565	7.7	33

Odor, offensive.—— The samples were collected from the separating tanks, and represent the sewage after a portion of the suspended matter had been separated from it.

Chemical Examination of Effluent from the

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11620	Jan. 9	Slight, milky.	None.	.04	Decidedly musty.	Decidedly musty.	27.90
2	11621	Jan. 9	None.	None.	.01	Decidedly musty.	Decidedly musty.	30.80
3	11769	Feb. 14	Very slight.	V. slight.	.00	Decidedly musty.	Decidedly musty.	28.10
4	11770	Feb. 14	Slight, milky.	Slight.	.00	Decidedly musty.	Decidedly musty.	28.90
5	11815	Feb. 27	Slight, milky.	Slight, rusty.	.08	Offensive.	Decidedly musty and disagreeable.	25.80
6	11816	Feb. 27	Slight, milky.	Slight, rusty.	.02	Decidedly musty.	Decidedly musty and disagreeable.	26.20
7	11887	Mar. 13	Slight, milky.	None.	.15	Offensive.	Offensive.	22.70
8	11888	Mar. 13	Distinct.	Very slight.	.25	Offensive.	Offensive.	23.60
9	11961	Mar. 27	Very slight, milky.	None.	.00	Decidedly musty and disagreeable.	Offensive.	26.25
10	11962	Mar. 27	Very slight, milky.	None.	.02	Offensive.	Offensive.	25.65
11	12039	April 14	Very slight.	None.	.02	Decidedly musty.	Decidedly musty.	26.00
12	12040	April 14	Very slight.	Cons., sand.	.01	Distinctly musty.	Decidedly musty.	26.70
13	12112	April 25	Very slight.	Very slight, white.	.03	Decidedly musty.	Offensive.	27.40
14	12113	April 25	Very slight.	Very slight.	.04	Decidedly musty.	Decidedly musty.	26.50
15	12190	May 9	Very slight.	Very slight.	.03	Offensive.	Decidedly musty.	27.20
16	12191	May 9	Slight, milky.	Slight.	.04	Offensive.	Offensive.	27.70
17	12363	June 11	Distinct, milky.	Slight, white.	.45	Offensive.	Decidedly musty and disagreeable.	26.60
18	12364	June 11	Very slight.	Very slight.	.10	Decidedly disagreeable.	Distinctly musty and disagreeable.	31.00
19	12523	July 10	Distinct, milky.	Slight, rusty.	.10	Decidedly disagreeable.	Decidedly musty.	44.50
20	12524	July 10	Distinct, milky.	Slight, rusty.	.25	Decidedly disagreeable and musty.	Distinctly musty and disagreeable.	46.50
21	12721	Aug. 9	Distinct, white.	Slight, white.	.20	Distinctly musty, very disagreeable.	Distinctly musty and disagreeable.	44.20
22	12722	Aug. 9	Decided.	Cons.	.30	Distinctly musty and disagreeable.	Distinctly musty and offensive.	30.90
23	12947	Sept. 12	Decided, milky.	Slight.	.30	Decidedly disagreeable.	Distinctly disagreeable.	43.50
24	12948	Sept. 12	Decided, milky.	Slight, white.	.30	Decidedly disagreeable.	Decidedly offensive.	37.30
25	13127	Oct. 12	Distinct, milky.	Cons., rusty.	.18	Offensive.	Offensive.	41.20
26	13128	Oct. 12	Slight.	Slight, gray.	.10	Offensive.	Offensive.	35.10
27	13317	Nov. 14	Distinct.	Slight, white.	.15	Offensive.	Offensive.	29.10
28	13318	Nov. 14	Slight.	Very slight.	.08	Offensive.	Decidedly musty and disagreeable.	33.00
29	13482	Dec. 13	Distinct, white.	Cons., white.	.03	Decidedly musty and disagreeable.	Offensive.	32.50
30	13483	Dec. 13	Slight.	Cons.	.05	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	26.40
31	Av.	....	....	....	.13	....	....	32.18

Under-drains of the Marlborough Filter-beds.

[Parts per 100,000.]

Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.	
Free.	Albuminoid.		Nitrates.	Nitrites.				
0.3600	.0130	4.23	1.6000	.0070	.1911	9.1	.0070	1
0.3800	.0060	5.42	1.7500	.0050	·1014	9.0	.0000	2
0.4400	.0170	5.18	0.9000	.0030	.1944	7.7	.0000	3
0.4400	.0200	5.77	1.1000	.0070	.2136	8.9	.0000	4
0.4720	.0190	4.65	0.7500	.0130	.2840	8.0	.0700	5
0.4600	.0140	4.61	0.7800	.0070	.2368	7.3	.0280	6
0.3120	.0110	3.83	0.5800	.0340	.2384	6.4	·0600	7
0.3600	.0190	3.94	0.6000	.0200	.2640	7.6	.1000	8
0.2480	.0170	4.40	1.0000	.0100	.1694	8.1	.0125	9
0.5200	.0130	4.41	1.0000	.0140	.1617	7.8	.0250	10
0.4600	.0210	4.20	0.9500	.0130	.2120	7.1	.0020	11
0.2400	.0080	4.21	1.0500	·0080	.1744	8.3	.0020	12
0.2400	.0270	4.38	1.1000	.0130	.1896	7.6	.0080	13
0.1720	.0140	4.38	1.0000	.0160	.1635	7.7	.0180	14
0.2320	.0270	5.00	0.7000	.0100	.2870	7.0	.0100	15
0.3600	.0350	4.96	0.7500	.0080	.3485	6.9	.0120	16
0.7000	.0680	5.44	0.3500	.0180	.5197	7.0	-	17
0.4000	.0300	5.58	0.9500	.0050	.2487	8.6	-	18
0.6000	.0500	6.33	1.6600	.0180	.3888	12.6	.0050	19
0.5200	.0440	6.39	0.3000	.0110	.3811	12.6	.0460	20
0.5800	.0700	7.00	2.5000	.0120	.5505	9.3	.0300	21
1.0000	.0830	6.40	0.8000	.0150	.6391	6.3	.0750	22
0.5920	.0810	7.80	1.5000	.0800	.8008	8.4	.0300	23
0.8160	.0670	7.59	1.2500	.0600	.6468	7.0	.0450	24
0.3840	.0350	7.42	2.0800	.0080	.3078	8.9	.2750	25
0.5400	.0380	7.00	1.3000	.0140	.3610	8.1	.1100	26
0.8960	.0660	5.90	0.9800	.0120	.5850	6.9	.0170	27
0.4560	.0250	6.38	1.1600	.0120	.3315	8.6	.0150	28
0.3200	.0300	5.75	1.2400	.0030	.3080	8.6	.0150	29
0.6400	.0330	4.93	0.8000	.0040	.3103	7.0	.0230	30
0.4983	.0375	5.69	1.1281	.0159	.3566	8.3	.0366	31

Chemical Examination of Effluent from the

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1895.						
1	13650	Jan. 11	Slight.	Very slight.	0.05	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	26.10
2	13651	Jan. 11	Slight.	Very slight.	0.05	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	27.20
3	13716	Jan. 23	Slight, milky.	Cons., reddish.	0.03	Offensive.	Offensive.	25.50
4	13717	Jan. 23	Slight, milky.	Very slight.	0.10	Offensive.	Offensive.	28.90
5	13858	Feb. 18	Slight.	Cons., white.	0.18	Decidedly musty and disagreeable.	Offensive.	30.80
6	13859	Feb. 18	Very slight.	Slight.	0.15	Decidedly musty and disagreeable.	Decidedly musty and disagreeable.	29.30
7	13902	Feb. 28	Distinct, slight scum.	Slight.	0.20	Offensive.	Offensive.	28.90
8	13903	Feb. 28	Decided, white.	Slight.	0.65	Offensive.	Offensive.	27.20
9	13985	Mar. 15	Distinct.	Slight.	0.18	Offensive.	Offensive.	19.50
10	13986	Mar. 15	Distinct.	Slight.	0.15	Offensive.	Offensive.	19.30
11	14050	Mar. 26	Slight, milky.	Slight.	0.10	Decidedly musty and disagreeable.	Offensive.	20.40
12	14051	Mar. 26	Distinct.	Slight.	0.40	Decidedly musty and disagreeable.	Offensive.	20.30
13	14136	April 10	Distinct.	Slight.	0.05	Decidedly musty and disagreeable.	Offensive.	31.70
14	14137	April 10	Slight.	Slight, rusty.	0.04	Decidedly musty and disagreeable.	Offensive.	28.20
15	14365	May 22	Distinct.	Slight.	0.10	Offensive.	Offensive.	28.10
16	14366	May 22	Distinct.	Cons.	0.17	Offensive.	Offensive.	29.20
17	14476	June 17	Decided.	Slight.	0.25	Decidedly disagreeable and musty.	Decidedly disagreeable and musty.	41.70
18	14477	June 17	Distinct.	Slight.	0.10	Decidedly disagreeable and musty.	Decidedly disagreeable and musty.	37.00
19	14650	July 17	Slight.	Slight.	0.20	Offensive.	Offensive.	38.20
20	14651	July 17	Very slight.	Cons., dark.	0.15	Decidedly musty and disagreeable.	Offensive.	39.60
21	14814	Aug. 11	Distinct.	Heavy, yellow.	0.33	Offensive.	Offensive.	27.40
22	14815	Aug. 11	Slight.	Slight.	0.28	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	36.00
23	15216	Sept. 17	Slight.	Slight, earthy.	0.10	Decidedly disagreeable.	Decidedly musty and disagreeable.	34.30
24	15217	Sept. 17	Decided, iron.	Slight, rusty.	0.12	Decidedly disagreeable.	Decidedly disagreeable.	33.60
25	15398	Oct. 16	Distinct, milky.	Cons.	0.11	Offensive.	Offensive.	28.00
26	15399	Oct. 16	Very slight.	Cons.	0.15	Offensive.	Offensive.	27.50
27	15552	Nov. 14	Very slight, milky.	Very slight.	0.10	Distinctly vinous.	Distinctly musty.	24.70
28	15553	Nov. 14	Slight.	Slight.	0.05	Faintly musty.	Distinctly musty.	29.60
29	15728	Dec. 11	Slight, milky.	Very slight.	0.18	Faintly musty.	Distinctly musty.	21.00
30	15729	Dec. 11	Very slight.	Slight, rusty.	0.05	Distinctly musty.	Distinctly musty.	23.70
31	15812	Dec. 26	Very slight.	Very slight.	0.05	Faintly musty.	Decidedly musty.	23.60
32	15813	Dec. 26	Slight.	Slight.	0.05	Distinctly unpleasant and musty.	Distinctly offensive.	24.30
33	Av.	....	....	....	0.15	....	....	29.70

The samples were collected from the under-drains, generally from those beneath

Under-drains of the Marlborough Filter-beds — Concluded.

[Parts per 100,000.]

Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.	
Free.	Albu-minoid.		Nitrates.	Nitrites.				
0.8480	.0390	4.84	0.8200	.0010	.3357	7.4	.0060	1
0.4960	.0250	5.16	0.9500	.0010	.2370	7.1	.0140	2
0.6720	.0170	4.80	0.8000	.0070	.2828	7.1	.1200	3
0.4000	.0220	4.80	1.1000	.0060	.2409	9.7	.0280	4
0.4240	.0200	5.65	1.0500	.0050	.1638	7.9	.0630	5
0.4800	.0180	5.45	1.2000	.0100	.2964	8.3	.0340	6
0.8800	.0340	5.75	1.7000	.0120	.4068	8.1	.0750	7
1.5360	.0720	6.05	0.2650	.0180	.7070	8.1	.2050	8
0.6400	.0380	3.80	0.2500	.0120	.3673	6.0	.0950	9
0.7680	.0300	4.00	0.2150	.0080	.3476	5.7	.0540	10
0.6720	.0460	4.00	0.2500	.0180	.3157	5.6	.0400	11
0.8000	.0320	4.10	0.1800	.0270	.4004	6.4	.1300	12
0.3440	.0200	4.55	1.4000	.0080	.2194	8.9	.0680	13
0.1680	.0160	3.80	1.2000	.0030	.2194	7.9	.0320	14
0.2880	.0220	5.90	0.4500	.0040	.3534	7.4	.0450	15
0.6200	.0380	6.00	0.6800	.0450	.4218	7.7	.0860	16
2.8160	.0540	7.20	1.1000	.0220	.5008	11.0	.3050	17
0.5040	.0320	6.20	0.9300	.0150	.3724	10.6	.2300	18
0.9440	.0420	7.65	1.6500	.0180	.2400	10.0	.0650	19
0.5600	.0220	7.30	1.2800	.0060	.2512	9.9	.0780	20
0.9280	.0720	7.00	0.1800	.0060	.9360	6.3	.2800	21
0.5600	.0240	6.80	0.8000	.0070	.4446	9.0	.0670	22
0.6240	.0240	7.10	1.2000	.0140	.3533	7.0	.2800	23
0.4800	.0380	6.60	1.1000	.0500	.5382	7.3	.1050	24
0.7360	.0340	5.20	0.7200	.0080	.3666	6.4	.1550	25
0.3040	.0340	4.70	1.2000	.0080	.2668	6.0	.0500	26
0.3680	.0120	4.80	0.8000	.0022	.2184	6.7	.0300	27
0.2640	.0090	5.20	1.3000	.0024	.1833	8.1	.0080	28
0.2400	.0140	3.60	0.6000	.0050	.1560	7.1	.0100	29
0.4160	.0130	3.89	0.9800	.0020	.1638	6.7	.0650	30
0.2400	.0170	4.06	0.5300	.0070	.1540	6.3	.0070	31
0.3200	.0140	3.84	0.6000	.0030	.1848	6.6	.0250	32
0.6427	.0299	5.54	0.9056	.0120	.3444	7.8	.0987	33

the beds to which sewage was being applied at the time the sample was collected.

Chemical Examination of Water from the Brook into which the

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.	
			Turbidity.	Sediment.	Color.	Cold.	Hot.
		1894.					
1	12192	May 9	Very slight.	Slight, brown.	.55	Decidedly musty and disagreeable.	Distinctly musty.
2	12723	Aug. 9	Slight.	Slight.	.25	Distinctly vegetable and musty.	Distinctly vegetable and musty.
3	12949	Sept. 12	Slight.	Cons.	.12	Faintly disagreeable.	Distinctly musty.
4	13319	Nov. 14	Slight.	Cons.	.30	Faintly musty.	Decidedly musty.
5	Av.	....	....	....	.31	....	....
		1895.					
6	14478	June 17	Slight.	Cons.	.20	Distinctly disagreeable and musty.	Distinctly musty.
7	14652	July 17	Very slight.	Cons.	.28	Decidedly musty and disagreeable.	Faintly vegetable and musty.
8	14816	Aug. 11	Slight.	Slight.	.18	Faintly vegetable and musty.	Distinctly vegetable and musty.
9	15218	Sept. 17	Slight, rusty.	Cons., rusty.	.10	Faintly musty.	Distinctly musty.
10	Av.	....	....	....	.19	....	....

Iron, .0270. —— The samples were collected from the brook, at the road crossing below

Sewage Disposal at Medfield.

A system of sewage disposal by intermittent filtration was introduced at Medfield in 1886, and was described in the nineteenth annual report of the Board for the year 1887. Up to the end of 1895 connections had been made with 1 hotel, 3 houses and a large straw factory, in which, at times, as many as 900 operatives are employed. The original area of the beds was about 1 acre. The material is mostly coarse gravel. As the level of the ground water is about 10 feet below the surface of the filter, there are no under-drains. There are 4 beds, the surfaces of which are somewhat uneven, each of which, as a general rule, takes the sewage in turn for two days. It was found that there was considerable loam a

Effluent from the Marlborough Sewage Filter-beds is discharged.

[Parts per 100,000.]

Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	
			Albuminoid.								
Total.	Loss on Ignition.	Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.			
17.50	7.50	.0880	.0250	.0190	.0060	2.79	0.4400	.0120	.6380	4.3	1
27.85	10.10	.0900	.0330	.0195	.0135	4.70	1.5400	.0280	.3542	6.7	2
33.35	13.35	.3200	.0210	.0130	.0080	5.44	1.3750	.0470	.3388	6.4	3
24.80	8.70	.2280	.0250	.0210	.0040	4.26	0.9300	.0140	.4485	4.9	4
25.88	9.91	.1815	.0260	.0181	.0079	4.30	1.0712	.0253	.4449	5.6	5
26.40	8.90	.4000	.0330	.0200	.0130	4.40	0.5000	.0160	.3393	6.4	6
27.20	10.90	.4320	.0240	.0160	.0080	5.20	0.9000	.0380	.4275	6.9	7
28.20	8.50	.2240	.0180	.0140	.0040	5.50	0.6500	.1000	.5070	6.3	8
28.40	9.30	.0960	.0180	.0150	.0030	5.60	1.1000	.0300	.2948	5.7	9
27.55	9.40	.2880	.0232	.0162	.0070	5.17	0.7875	.0710	.3921	6.3	10

the filter-beds and below where the effluent from the filter-beds enters the stream.

short distance below the surface of a portion of the beds, which eventually became clogged. In the summer of 1893 this loam was removed and replaced with coarse gravel, and the area of the filter increased about one-third. Several times during the warm weather the surfaces were harrowed, but they have not been ridged for service in the winter.

No trouble has arisen from odors. In the following tables will be found analyses of the sewage, and of the effluent taken from a spring a short distance below the filter. The effluent is of excellent quality, and no marked deterioration is shown by the analyses when compared with those made in 1887, after the works had been in operation for a comparatively short time.

Chemical Examination of

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color *	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
1	11761	Feb. 14	Thick, green.	Heavy, dark.	-	41.20	33.40	7.80	21.60	14.80	6.80
2	12360	June 12	Thick, black.	Cons., black.	-	26.80	22.80	4.00	13.20	10.00	3.20
3	12701	Aug. 9	Thick.	Cons., dark.	-	59.40	47.40	12.00	37.20	28.40	8.80
4	13210	Oct. 24	Thick, colored.	Heavy, black.	-	80.20	63.40	16.80	36.00	26.80	9.20
5	13477	Dec. 12	Decided.	Heavy.	8.50	30.60	27.80	2.80	14.20	12.40	1.80
6	Av.	....	....	....	-	47.64	38.96	8.68	24.44	18.48	5.96
7	13820	Feb. 13	Black, opaque.	Heavy.	-	112.80	103.40	9.40	43.20	34.60	8.60
8	14124	April 10	Opaque.	Opaque.	-	98.00	86.40	12.20	44.40	34.40	10.00
9	14525	June 21	Decided.	Heavy.	6.00	37.80	32.80	5.00	16.80	12.60	4.20
10	14846	Aug. 15	Opaque.	Considerable.	-	46.40	41.60	4.80	29.40	23.80	5.60
11	15395	Oct. 17	Decided.	Considerable.	0.70	20.20	18.50	1.70	5.00	4.10	0.90
12	15725	Dec. 11	Opaque.	Considerable.	-	31.00	25.60	5.40	13.00	8.80	4.20
13	Av.	....	....	....	-	57.80	51.38	6.42	25.30	19.72	5.58

* The color of many of these samples was affecte l by the presence of spent dye liquors in the sewage,

Chemical Examination of Water from a Spring below

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.
			Turbidity.	Sediment.	Color.	Cold.	Hot.	
		1894.						
1	11669	Jan. 22	None.	Slight.	0.00	None.	Very faint or none.	6.95
2	11762	Feb. 14	Very slight.	Slight.	0.02	Very faint or none.	Very faint or none.	9.60
3	12361	June 12	None.	Slight.	0.04	Very faint or none.	Distinct, peculiar.	11.20
4	12702	Aug. 9	Very slight.	Slight, earthy.	0.05	None	Very faint or none.	10.50
5	13211	Oct. 24	None.	Very slight.	0.04	Very faint or none.	Very faintly musty.	22.50
6	13478	Dec. 12	Very slight.	Slight.	0.65	Very faint or none.	Faintly vegetable	16.40
7	Av.	....	....	....	0.13	....	....	12.86
		1895.						
8	13821	Feb. 13	Slight.	Cons.	0.03	None.	None.	4.70
9	14125	April 10	Very slight, milky.	Cons , earthy.	0.75	Faintly unpleasant.	Faintly vegetable.	12.60
10	14526	June 21	Very slight.	Cons.	0.23	Faintly vegetable, unpleasant.	Faintly vegetable.	9.30
11	14847	Aug. 15	Slight.	Cons.	0.12	Very faint or none.	Faintly vegetable.	9.40
12	15396	Oct. 17	Slight.	Cons.	1.10	Distinctly vegetable.	Distinctly vegetable.	40.10
13	15726	Dec. 11	Slight.	Slight.	0.07	Very faint or none.	Very faint or none	4.70
14	Av.	....	....	....	0.38	....	....	13.47

The samples were collected from the spring, which is located north of the filter-beds and a little the direction of this spring.

Sewage from Medfield.

[Parts per 100,000.]

Ammonia.					Nitrogen as		Oxygen Consumed.		Iron.			
	Albuminoid.											
Free.	Total.	Dis-solved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.	Hardness.	
1.2800	0.9260	0.8260	.1000	2.40	.0050	.0100	4.7200	3.8800	0.0400	.0200	2.9	1
0.3600	0.2300	0.1300	.1000	1.27	–	.0010	4.9434	3.9116	–	–	2.6	2
10.8800	1.8000	1.5000	.3000	2.38	.0000	.0000	–	6.1600	–	–	6.5	3
0.2640	0.3660	0.2660	.1000	2.72	.0000	.0000	13.9830	10.8625	1.3000	.0660	6.7	4
0.2960	0.2600	0.2040	.0560	1.80	.0050	.0040	5.0050	3.9270	0.0520	.0400	4.6	5
2.6160	0.7164	0.5852	.1312	2.11	.0025	.0030	7.1629	5.7482	0.4640	.0447	4.7	6
2.8800	1.6000	1.5200	.0800	4.15	.0000	.0000	10.0800	6.9200	0.1000	.0640	33.0	7
0.9920	0.9700	0.7060	.2640	7.10	.0000	.0050	18.5570	16.4780	0.5500	.3000	10.0	8
0.8960	0.4240	0.2720	.1520	3.80	.0000	.0000	5.0050	4.1965	0.1300	.0900	3.2	9
1.7280	0.4740	0.2980	.1760	2.70	.0000	.0000	28.5480	22.6200	0.3000	.3000	4.0	10
0.2320	0.0880	0.0500	.0380	2.30	.0250	.0500	1.5600	1.0920	0.0330	.0200	5.3	11
1.4400	0.3100	0.2900	.0200	2.50	.0080	.0000	6.0060	3.9936	–	–	4.3	12
1.3613	0.6443	0.5227	.1216	3.76	.0056	.0092	11.6260	9.2167	0.2226	.1548	10.0	13

and in many cases could not be determined satisfactorily.

Odor, offensive. —— The samples were collected as the sewage flowed upon the filter-beds.

the Filtration Area of the Medfield Sewerage System.

[Parts per 100,000.]

Ammonia.			Nitrogen as					
Free.	Albu-minoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.	
.0002	.0034	1.36	0.2000	.0000	0.1106	3.0	.0025	1
.0004	.0056	1.19	0.1500	.0000	0.1200	2.7	.0100	2
.0008	.0042	0.95	0.1250	.0000	0.0385	2.9	–	3
.0006	.0070	0.98	0.3000	.0002	0.1101	3.6	.0010	4
.0010	.0120	1.22	0.9000	.0001	0.2054	6.7	.0050	5
.0132	.0284	1.82	0.2400	.0000	0.5698	3.6	.0030	6
.0027	.0101	1.25	0.3192	.0001	0.1924	3.8	.0043	7
.0014	.0042	0.40	0.1100	.0001	0.1344	1.8	.0010	8
.0066	.0160	1.15	0.3000	.0006	0.6406	3.5	.0030	9
.0004	.0100	0.76	0.1000	.0002	0.4081	2.3	.0120	10
.0058	.0130	0.97	0.1100	.0020	0.2106	4.2	.0250	11
.0550	.0910	6.00	1.0500	.0008	1.3806	12.9	.0090	12
.0000	.0030	0.51	0.1000	.0003	0.1108	1.6	.0050	13
.0115	.0229	1.63	0.2950	.0007	0.4808	4.4	.0092	14

over 260 feet from the edge of the nearest bed. The ground where the filter-beds are located slopes in

FOOD AND DRUG INSPECTION.

FOOD AND DRUG INSPECTION.

The following report comprises the operations of the Board under the provisions of the food and drug acts for the year ending Sept. 30, 1895.

The force employed by the Board during the year consisted of the following persons: —

Dr. Charles P. Worcester,	*Analyst.*
Prof. Charles A. Goessmann,	*Analyst.*
Mr. Albert E. Leach,	*Assistant Analyst.*
John H. Terry,	*Inspector.*
John F. McCaffrey,	*Inspector.*
Horace F. Davis,	*Inspector.*
Thomas O. Allen,	*Inspector.*

In addition to the force employed in 1894, Mr. Thomas O. Allen was appointed by the Board in 1895, to act in the towns in the neighborhood of Lowell.

The whole number of samples of food and drugs (including milk) examined during the year was 7,309, or 435 more than the number examined in the year ending Sept. 30, 1894, and 1,405 more than the average annual number examined in the ten years from Sept. 30, 1885, to Sept 30, 1895.

The whole number examined since the beginning of operations in this department in 1883 was 67,756.

The following summary embraces the work done during the year: —

Number of samples of milk examined,	3,794
Number of samples above standard,	1,905
Number of samples below standard,	1,889
Percentage of adulteration or deficiency,	49.8
Number of samples of other kinds of food (not milk),	2,971
Number of samples above standard,	2,379
Number of samples below standard,	592
Percentage of adulteration,	19.9

Number of samples of drugs examined,	544
Number of samples of good quality,	212
Number of samples adulterated, as defined by the statutes,	332
Percentage of adulteration,	61.0

Total number of samples of food and drugs examined,	7,309
Total number found to be of good quality,	4,496
Total number not conforming to the statutes,	2,813
Percentage of adulteration,	38.5

Attention has already been called, in previous reports, to the fact that the percentages given in the foregoing summary do not represent, in any degree, the actual ratio of adulteration existing in food products and in drugs, for several reasons: chiefly on account of the fact that the experience of the Board enables it, first, to exercise a careful selection of such articles, mainly, as are liable to adulteration; secondly, to obtain such articles in those seasons of the year when their adulteration is most common; and third, to pay special attention to new forms of adulteration which are constantly appearing as fast as the fraud and ingenuity of the professional adulterator presents them to the public.

Legislation itself has an effect upon the ratio of samples found to be adulterated. For example, in 1885, 273 samples of vinegar were examined and 81 per cent. were found to be below the standard. Had these samples been examined in the following year, only 61 per cent. would have fallen below the standard, since the standard of acetic acid in vinegar was reduced by the law of 1885 from 5 per cent. to 4½ per cent. and about 20 per cent. of the number of samples were found to range between 4½ and 5 per cent.

The following tables present a summary of the work done during the entire period from the beginning of operations under the food and drug acts in 1883 to the close of the year ending Sept. 30, 1895: —

STATISTICAL SUMMARY.

Food and Drug Inspection (1883-95).

Summary.	Years.						
	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Number of samples of milk examined,	218	1,123	2,219	2,085	3,081	2,825	3,219
Number of samples above standard,	35	347	1,297	1,323	1,900	1,705	1,971
Number of samples below standard,	183	776	922	762	1,181	1,120	1,248
Percentage of adulteration,	83.9	69.1	41.7	36.5	38.3	39.6	38.7
Number of samples of other kinds of food (not milk),	477	839	1,552	1,353	1,789	2,079	1,635
Number of samples of good quality,	328	432	883	863	1,263	1,680	1,242
Number of samples adulterated, as defined by the statutes,	149	407	669	490	556	399	393
Percentage of adulteration,	31.2	48.5	43.1	36.2	29.4	19.2	24.0
Number of samples of drugs examined,	603	682	1,007	888	550	862	600
Number of samples of good quality,	357	431	571	463	400	634	503
Number of samples adulterated, as defined by the statutes,	246	251	436	425	150	228	97
Percentage of adulteration,	40.8	36.8	43.3	47.8	27.3	26.4	16.2
Total examinations of food and drugs,	1,298	2,644	4,778	4,326	5,420	5,766	5,454
Total examinations of good quality,	720	1,210	2,751	2,649	3,563	4,019	3,716
Total examinations not conforming to the statutes,	578	1,434	2,027	1,677	1,857	1,747	1,738
Percentage of adulteration,	44.5	54.2	42.7	38.7	34.3	30.3	31.9
Expense of collection, examination and prosecution,	$2,931 56	$5,529 60	$8,557 43	$8,025 34	$8,803 62	$8,915 41	$10,356 28
Expense of collection, examination and prosecution, per sample,	2 26	2 09	1 79	1 85	1 62	1 54	1 89

FOOD AND DRUG INSPECTION (1883-95) — *Concluded.*

SUMMARY.	Years.						Totals.
	1890.	1891.	1892.	1893.	1894.	1895.	
Number of samples of milk examined,	3,236	2,726	3,271	3,073	3,551	3,794	34,421
Number of samples above standard,	1,858	1,629	1,757	1,545	1,794	1,905	19,066
Number of samples below standard,	1,378	1,097	1,514	1,528	1,757	1,889	15,355
Percentage of adulteration,	42.6	40.2	46.3	49.7	49.5	49.8	44.6
Number of samples of other kinds of food examined (not milk),	2,349	2,144	2,441	3,009	2,836	2,971	25,474
Number of samples of good quality,	1,913	1,577	2,042	2,637	2,566	2,379	19,805
Number of samples adulterated, as defined by the statutes,	436	567	399	372	270	592	5,669
Percentage of adulteration,	18.6	26.4	16.3	12.3	9.5	19.9	22.3
Number of samples of drugs examined,	400	424	487	327	487	544	7,861
Number of samples of good quality,	325	352	312	228	324	212	5,112
Number of samples adulterated, as defined by the statutes,	75	72	175	99	163	332	2,749
Percentage of adulteration,	18.7	17.0	35.9	30.3	33.5	61.0	35.0
Total examinations of food and drugs,	5,985	5,294	6,199	6,409	6,874	7,309	67,756
Total examinations of good quality,	4,096	3,558	4,111	4,410	4,684	4,496	43,983
Total examinations not conforming to the statutes,	1,889	1,736	2,088	1,999	2,190	2,813	23,773
Percentage of adulteration,	31.5	32.8	33.7	31.2	31.9	38.5	35.1
Expense of collection, examination and prosecution,	$10,013 04	$10,019 41	$11,180 30	$10,454 11	$10,364 64	$11,375 89	$116,526 63
Expense of collection, examination and prosecution, per sample,	1 67	1 89	1 80	1 63	1 52	1 56	1 72

The removal of the office of the Board, as well as the laboratory for food and drug analysis, to the present quarters under one roof at the State House has proved to be a matter of great convenience, since it not only allows a greater amount of work to be done, but also affords better opportunity for consultation between the Board and its analysts in all difficult and doubtful cases.

Milk.

The great importance of milk as an article of food for all classes of people, and especially for the young, the ease with which its adulteration is accomplished and the difficulty of its detection by the ordinary consumer, constituted a sufficient reason for the legal requirement that a definite and comparatively large ratio of the expense of carrying out the provisions of the law should be employed in the inspection of milk and its products.

The questions pertaining to commercial fraud in the sale of milk products (milk, butter and cheese) are sufficiently provided for by existing laws, and there appears to be a tendency at the present time towards legislation in the more important direction of the sanitary control of the milk supply. The recent acts providing for the inspection of milch cows, and the destruction of such as are found to be diseased, undoubtedly give greater security to the consumers of milk.

While this is eminently desirable, it is quite as necessary that legislation should provide for prevention of the recurrence of disease in the future by requiring the frequent inspection, by competent authority, of the places in which dairy animals are kept for the production of milk, and that special attention should be paid to their housing, their water supply, the ventilation and drainage of their stables and the quality of their food.

During the past few years the Board has been called upon frequently to investigate the causes of outbreaks of typhoid fever, and in several instances the medium of infection has been found to be the milk supply. It is needless to add that carelessness in management and want of cleanliness in some of the details of dairy work were invariably found to exist in such cases. Local boards of health will accomplish much by encouraging the establishment of *model dairies*, in which milk is produced and prepared for sale under the best possible conditions. The cost of such milk may be a little higher to the consumer, but the security which is gained will pay in the end. The game is well worth the candle.

Several points in the reports of the analysts are worthy of note. The appearance, during the year, of a comparatively new coloring matter, employed in the adulteration of milk, has led to a careful investigation of its character and composition. The substance employed is an aniline dye, and the quantity required to produce the color of a rich milk is quite small. Fortunately, the dye is easy of detection when introduced into milk, as is shown in the report of the analyst.

Attention is called to the figures showing the results of analysis in a case where the analysis of nine samples was made by three chemists, the chemist of the Board and two others to whom the samples were submitted. The greatest difference in these analyses was only $\frac{13}{100}$ of one per cent.

The claim is often urged by milk producers that it is impossible to produce milk which shall uniformly satisfy the requirements of the law, and instances are adduced of single animals of some particular breed which produce milk of a quality considerably below the legal standard. To the influence thus produced by the employment of breeds which furnish milk of a low standard is added the effect of using impoverished food, which tends to increase the quantity of milk at the expense of its quality.

It is, however, rare to find a herd of cows, consisting, as is usually the case, of a variety of breeds, in which the average mixture of the milk of the dairy falls below the legal standard of solids. It is not an uncommon event to find that the milk taken on the street from wagons, under the ordinary conditions of delivery, is nearly or quite as good as that which is produced at the dairies.

The following is a fair samp'e of a single collection of milk made in one city in the month of July, when the legal standard is 12 per cent. : —

Inspector's Number.	Total Solids.	Wagon or Shop.	Inspector's Number.	Total Solids.	Wagon or Shop.
8421, ...	13.94	Wagon.	8443, . .	13.50	Wagon.
8423, ...	13.10	Wagon.	8445, . .	12.27	Wagon.
8425, ...	12.00	Wagon.	8447, . .	13.35	Wagon.
8427, ...	12.70	Wagon.	8449, . .	12.64	Wagon.
8429, ...	12.74	Wagon.	8451, . .	15.67	Wagon.
8431, ...	12.23	Wagon.	8453, . .	12.82	Wagon.
8433, ...	12.77	Wagon.	8455, . .	12.40	Wagon.
8435, ...	13.03	Wagon.	8457, . .	12.84	Wagon.
8437, ...	13.46	Wagon.	8459, . .	12.64	Wagon.
8439, ...	12.60	Wagon.			
8441, ...	13.00	Wagon.	Average, .	12.98	

A table of analyses of different brands of condensed milk is presented in the report, showing at the first glance a fairly uniform quality in the samples examined. Close inspection, however, shows considerable differences in their composition, so far as they relate to the original nutrient constituents of the milk from which the samples were made. For example, the proteids showed a maximum of 9.83 per cent. and a minimum of 5.95 per cent., the milk sugar a maximum of 20.06 per cent. and a minimum of 7.05 per cent., and the fat a maximum of 12.3 per cent. and a minimum of 7.4 per cent.

The average constituents of the thirty-three samples were as follows: —

Total solids,	72.32
Water,	27.76
Milk solids,	32.37
Cane sugar,	39.94
Milk sugar,	13.01
Proteids,	8.10
Fat,	9.69
Ash,	1.58
Fat in original milk,*	4.05

As is quite commonly the case, the prices at which these different brands were sold afforded no indication of their comparative quality.

Local Inspection.

The statutes provide that in every city there *shall* be a local inspector of milk, while in the towns the law is permissive only. As the towns increase in population, especially in the metropolitan district, the number in which milk inspectors are provided by the municipal authorities annually increases, and thus greater protection is constantly afforded against the adulteration of this important food. It is desirable that every town having a population of more than five thousand inhabitants should appoint an inspector, and give him such support in carrying out the law as the subject demands.

Butter.

The fact that more than 97 per cent. of the samples of butter obtained by the inspectors (186 out of 191 samples) proved to be genuine is a fair indication of the methods of sale of this article in open market, and of the extent of adulteration or of illegal sales,

* Assuming a standard of 9.3 per cent. for solids not fat.

since the inspectors in obtaining samples of butter at retail have diligently sought for places where adulteration would be most liable to exist.

Lard.

Special attention has been paid by the analyst to the examination of lard and to the different methods of detection of its two principal adulterants, — cotton seed oil and the fats of beef, — since the presence of adulterated lard in the cities of Massachusetts has increased quite recently to a considerable degree.

Spices.

The examination of spices shows a wholesome state of the market as compared with that of 1883–84 (the beginning of operations under the food acts), when 65 per cent. of spices examined were found to be adulterated. The percentage of adulteration last year was 16.3 per cent., or about one-fourth of that which prevailed a dozen years since.

Maple Syrup and Sugar.

These valuable products of the rock or sugar maple tree have been made the subjects of careful study, and some advance has been made in the matter of distinguishing the different varieties of sugar which closely resemble cane sugar in their chemical composition. The rough inspection afforded by the senses of sight, taste and smell still give important aid in the examination of these articles.

Egg Substitutes.

The analysis of these preparations shows how little reliance can be placed in the statements of the inventors or manufacturers of new or patent food preparations with reference to their actual nutrient value.

Cooking Utensils.

While the food and drug act of Massachusetts does not provide, as in some countries, for the inspection of the utensils in which food is prepared for use, the Board has deemed it proper to make such investigations in this direction as may be necessary for the protection of the public. Considerable agitation having arisen during the year, as shown by comments in the newspapers, in regard to the possible danger which might arise from the use of "agate," "gran-

ite" or enamelled ware, which is largely sold for culinary purposes, the Board ordered an examination to be made. It had been charged that the enamelled coating of such utensils contained arsenic. Arsenic was found in only one instance, and in that case the quantity was inconsiderable and such only as might have been due to a slight impurity in the material used for glazing. More than half of the utensils contained antimony.

The following figures afford a very good illustration of the advantages secured by the enactment of a well-devised food and drug statute.

In 1884, soon after the enactment of the law and before an adequate appropriation had been provided for its enforcement, an examination of spices and cream of tartar, and other articles of food, as sold in open market in Massachusetts gave the following results: —

Samples of spices collected in 1884, 431. Number adulterated, 216, or 50.1 per cent.

Samples of spices collected in July, 1896, 78. Number adulterated, 2, or 2.6 per cent.

Samples of cream of tartar collected in 1884, 232. Number adulterated, 77, or 33.2 per cent.

Samples of cream of tartar collected in July, 1896, 25, of which 1 was adulterated, or 4 per cent.

Out of 123 samples of butter, cheese, tea, coffee and confectionery collected in 1884, 15, or 12.2 per cent., were adulterated.

Out of 82 samples of the same articles collected under similar conditions in July, 1896, all proved to be genuine.

Drugs.

The principal drugs found to be adulterated by the analyst are as follows: —

Ether, distilled water, extract of licorice, compound spirits of ether, spirits of nitrous ether (all below standard and more than half showing less than 50 per cent. of the required strength), the pharmacopœial wines and liquor, tincture of opium, officinal soap and mercuric ointment. Much greater care is necessary in the preparation of distilled water. Its use for preparing eye-lotions, for the solution of nitrate of silver and other salts, and many other purposes requiring pure water, calls for a carefully made article, and yet it was quite commonly found on analysis to be nothing but

the tap-water of the city or town supply, and in one instance it contained more impurities than ordinary sewage. It is needless to say that a conviction and fine followed close upon this sale.

Notices.

The following are the names of the cities and towns to which warning notices were sent during the year, stating that the parties to whom they were sent were found to be retailing food and drugs which were below the required standard of purity.

This form of notice was adopted for the purpose of giving information to retailers, where there is presumptive evidence that they are not aware of the fact that the articles in question are below the standard quality required by the statutes. Such notices are not required by the statutes, and failure to receive them does not exempt the retailer from liability to complaint at court.

Cities and Towns to which Notices were sent on Account of Adulterated Milk.

Barre,	2	Natick,	1
Bedford,	1	Newton,	4
Berlin,	2	Onset Bay,	1
Boston,	2	Peabody,	1
Brockton,	3	Provincetown,	2
Brookline,	1	Quincy,	3
Cambridge,	25	Revere,	4
Chelsea,	14	Rochester,	1
Clinton,	1	Salem,	4
Dedham,	6	Somerville,	18
Deerfield,	1	Stoneham,	4
Dover,	1	Stoughton,	2
Everett,	16	Sudbury,	3
Fall River,	8	Waltham,	2
Gardner,	2	Ware,	1
Gloucester,	8	Wareham,	1
Hardwick,	3	Watertown,	5
Haverhill,	2	West Newton,	6
Holliston,	1	Weston,	1
Holyoke,	3	Weymouth,	1
Hull,	2	Winchester,	5
Hyde Park,	5	Winthrop,	2
Lawrence,	6	Woburn,	18
Lexington,	1	Worcester,	3
Malden,	12		
Medford,	6	Total,	229
Nantucket,	2		

Cities and Towns to which Notices were sent on Account of Adulterated Articles of Food other than Milk.

Arlington,	2	Pittsfield,	1
Attleborough,	2	Plymouth,	2
Blackstone,	10	Provincetown,	2
Boston,	34	Salem,	1
Brockton,	1	Spencer,	2
Cambridge,	4	Springfield,	1
Fall River,	7	Stoneham,	1
Fitchburg,	2	Taunton,	1
Gardner,	1	Ware,	4
Gloucester,	1	Watertown,	2
Holyoke,	3	Westfield,	2
Lawrence,	2	Woburn,	2
Lowell,	6		
Lynn,	1	Total,	98
Onset,	1		

Cities and Towns to which Notices were sent on Account of Adulterated Drugs.

Adams,	1	North Adams,	4
Arlington,	2	Northampton,	1
Attleborough,	1	Peabody,	1
Blackstone,	1	Provincetown,	1
Boston,	16	Salem,	2
Cambridge,	7	Spencer,	1
Chelsea,	3	Springfield,	5
Fall River,	4	Stoneham,	1
Fitchburg,	1	Taunton,	1
Gardner,	2	Waltham,	4
Gloucester,	3	Westfield,	2
Holyoke,	8	West Medway,	1
Lowell,	1	West Newton,	1
Malden,	4	Winchester,	2
Marblehead,	1		
Melrose,	1	Total,	84
New Bedford,	1		

Prosecutions.

In the reports of the last three years a condensed summary was presented, showing the number of prosecutions conducted in each year since the beginning of work under the food and drugs acts. The following table presents the same figures, with the addition of those for the year ending Sept. 30, 1895: —

Number of Complaints entered in Court.

Year.	Food not including Milk.	Drugs.	Milk.	Total.	Convictions.	Fines Imposed.
1883,	–	5	4	9	8	–‡
1884,	2	1	45	48	44	–‡
1885,*	50	1	68	119	103	–‡
1886,†	10	–	10	20	19	–‡
1887,	30	–	34	64	60	–‡
1888,	22	–	43	65	61	$2,042 00
1889,	74	–	66	140	124	3,889 00
1890,	78	–	24	102	96	3,919 00
1891,	96	5	49	150	135	2,668 00
1892,	52	12	72	136	123	3,661 70
1893,	26	3	67	96	92	2,476 00
1894,	14	–	76	90	77	2,625 00
1895,	13	11	68	92	86	2,895 30
Totals,	467	38	626	1,131	1,028	$24,176 00

* To May 1, 1886. † Four months only. ‡ No record kept.

Ratio of convictions to complaints, 90.9 per cent.

Note. — All complaints entered before May 1, 1886, were under the direction of the Board of Health, Lunacy and Charity, and all after that date were under the direction of the State Board of Health.

The following report was presented to the Legislature in January, 1896, in compliance with the provisions of the statutes: —

Office of the State Board of Health,
State House, Boston, Jan. 9, 1896.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The following summary is made in compliance with the provisions of chapter 289, section 2, of the Acts of 1884, requiring the State Board of Health to "report annually to the Legislature the number of prosecutions made under chapter 263 of the Acts of 1882, and an itemized account of all money expended in carrying out the provisions thereof."

The whole number of prosecutions made by authority of the Board against offenders, under the provisions of the food and drug acts, for the year ending Sept. 30, 1895, was 92.

The cities and towns in which the articles were sold, and in respect to which complaints were entered in court, the character of the articles found to be adulterated, or fraudulently sold, the dates of the trials and their results, are presented in the following table: —

Milk and Milk Products.

For Fraudulent Sales of Milk.

Place.	Date.	Result.
In Marlborough,	Oct. 6, 1894,	Convicted.
Marlborough,	Oct. 6, 1894,	"
Marlborough,	Aug. 19, 1895,	"
Newton,	Oct. 19, 1894,	"
Fall River,	Oct. 5, 1894,	"
Fall River,	Oct. 11, 1894,	"
Fall River,	Oct. 11, 1894,	"
Gloucester,	Nov. 3, 1894,	"
Gloucester,	Nov. 3, 1894,	Discharged.
Gloucester,	May 22, 1895,	Convicted.
Gloucester,	Aug. 16, 1895,	"
Chelsea,	Nov. 30, 1894,	"
Chelsea,	Nov. 7, 1894,	"
Salem,	Dec. 21, 1894,	"
Salem,	Feb. 26, 1895,	"
Salem,	May 3, 1895,	"
Woburn,	Nov. 29, 1894,	"
Woburn,	May 10, 1895,	"
Woburn,	Aug. 21, 1895,	"
Waltham,	March 8, 1895,	"
Springfield,	March 22, 1895,	Discharged.
Springfield,	March 22, 1895,	Convicted.
Springfield,	April 5, 1895,	"
Chicopee,	June 28, 1895,	"
Medford,	Aug. 23, 1895,	"
Lowell,	Sept 6, 1895,	"
Milford,	Oct. 18, 1894,	"
Mendon,	Oct. 18, 1894,	"
Wrentham,	Oct. 20, 1894,	"
Gardner,	Nov. 24, 1894,	"
West Medway,	Nov. 24, 1894,	"
West Medway,	Nov. 24, 1894,	"
Danvers,	Jan. 18, 1895,	"
Danvers,	Feb. 26, 1895,	"
Peabody,	Jan. 26, 1895,	"
Peabody,	Jan. 28, 1895,	"
Peabody,	Feb. 19, 1895,	"

For Fraudulent Sales of Milk — Concluded.

Place.	Date.	Result.
In Peabody,	Feb. 26, 1895,	Convicted.
Peabody,	May 21, 1895,	"
Peabody,	May 21, 1895,	"
Peabody,	May 21, 1895,	"
Peabody,	Aug. 14, 1895,	"
Peabody,	Aug. 14, 1895,	"
Peabody,	Aug. 14, 1895,	"
North Brookfield,	March 19, 1895,	"
Bedford,	March 12, 1895,	"
Bedford,	July 22, 1895,	"
Natick,	July 26, 1895,	"
Ashland,	July 26, 1895,	"
Norwell,	April 26, 1895,	"
North Pembroke,	April 30, 1895,	"
West Springfield,	May 6, 1895,	Discharged.
Sherborn,	May 15, 1895,	"
Dover,	May 16, 1895,	"
Watertown,	July 19, 1895,	"
Milton,	July 12, 1895,	"
Billerica,	July 22, 1895,	"
Deerfield,	July 25, 1895,	"
Barre,	July 29, 1895,	"
Framingham,	July 31, 1895,	"
Westford,	Aug. 2, 1895,	"
Wenham,	Aug. 5, 1895,	"
Dedham,	Sept. 23, 1895,	"
Holliston,	Sept. 28, 1895,	"
Holliston,	Sept. 28, 1895,	"
Southborough,	Sept. 30, 1895,	"
Total,		66

For Fraudulent Sale of Oleomargarine.

In Peabody,	Feb. 27, 1895,	Convicted.
Peabody,	May 21, 1895,	"
Total,		2

FOR FRAUDULENT SALE OF OTHER ARTICLES OF FOOD.

Molasses.

In Lowell,	March 18, 1895,	Convicted.

Coffee.

In Lawrence,	Oct. 27, 1894,	Convicted.
Chelsea,	Dec. 19, 1894,	Discharged.
Holyoke,	April 26, 1895,	Convicted.
Boston,	June 4, 1895,	"

For Fraudulent Sale of Other Articles of Food — *Concluded.*

Cream of Tartar.

Place.	Date.	Result.
In North Adams,	Nov. 20, 1894,	Convicted.

Lard.

In Fall River,	March 6, 1895,	Convicted.

Maple Syrup.

In Lowell,	March 18, 1895,	Convicted.

Honey.

In Fall River,	March 22, 1895,	Convicted.

Spices and Condiments.

In Holyoke,	April 26, 1895 (cassia),	Convicted.
Holyoke,	April 26, 1895 (pepper),	"
Holyoke,	April 26, 1895 (mustard),	"
Ware,	Jan. 4, 1895 (mustard),	"

Drugs.

In Gardner,	Dec. 7, 1894 (Ruppert's Face Bleach),	Convicted.
Ware,	Dec. 4, 1894 (Ruppert's Face Bleach),	"
Holyoke,	Dec. 19, 1894 (Ruppert's Face Bleach),	"
Boston,	April —, 1895 (Ruppert's Face Bleach),	*
Boston,	April —, 1895 (Ruppert's Face Bleach),	*
Boston,	Dec. 31, 1894 (oxide of zinc ointment),	Convicted.
Boston,	Dec. 31, 1894 (mercurial ointment),	"
Woburn,	Dec. 2, 1894 (distilled water),	"
Ware,	Dec. 11, 1894 (distilled water),	"
Ware,	Dec. 8, 1894 (distilled water),	"
Revere,	Aug. 9, 1895 (distilled water),	"

Summary.

Complaints entered in court under the acts relating to the inspection of milk and milk products,	68
Other articles of food,	13
Drugs,	11
Total,	92

Summary.

The whole number of complaints entered by the State Board of Health during the year ending Sept. 30, 1895, in the courts of the Commonwealth, against parties for violation of the statutes relating to food and drug inspection, was 92.

* Parties left the State before case could be tried.

In 86, or 93.5 per cent., of these the parties were convicted. Four were discharged either in the district, municipal or superior courts, and in two cases the parties had left the State before warrants could be served.

Of the whole number, 66 were for violation of the laws relating to milk adulteration, and of this number 63 resulted in conviction. The greater number of these was for violation of the statute providing that milk offered for sale shall be of good standard quality.

In 1 of the foregoing cases the complaint was for sale of milk from a can not properly marked, 5 cases were for sales of milk containing coloring matter, and 1 was for a sale of milk containing boracic acid.

In one of the cases the defendant was discharged because his counsel would not admit the affidavit of the chemist as evidence.

In another case, in which the complaint was made for a sale of adulterated coffee, the defendant was discharged because the judge decided that it was not necessary to mark retail packages as "compound" in cases where the article was bought in bulk from a larger box or bin, to which the word "compound" was affixed.

The attention of the Legislature is respectfully called to the fact that, in consequence of the enactment of chapter 425 of the Acts of 1894, "relative to the inspection of milk," the defendants in two cases of milk adulteration which recently occurred in Franklin County were discharged. The actual amount of adulteration in these two cases was excessive, amounting to 40 or 50 per cent. of the samples in question.

Of the 13 complaints for fraudulent sales of other kinds of food, all of the parties were convicted except one. The articles of food embraced in in this list were as follows: —

Molasses, 1 case; coffee, 4 cases; mustard, 2 cases; cream of tartar, 1 case; honey, 1 case; pepper, 1 case; cassia, 1 case; lard, 1 case; maple syrup, 1 case.

The standard of whole milk in Massachusetts is 13 per cent. of solid residue, except in May and June, when it is 12 per cent. The following list presents the total solids in all the samples of milk upon which complaints were founded, so far as records of the same were kept: —

6.66	10.24	10.63	11.05	11.42
7.44	10.26	10.72	11.12	11.46
8.79	10.30	10.80	11.16	11.46
8.90	10.38	10.84	11.16	11.57
9.22	10.38	10.86	11.18	11.58
9.60	10.40	10.86	11.26	11.65
9.63	10.42	10.87	11.27	11.66
9.84	10.47	10.87	11.28	11.70
9.87	10.56	10.90	11.30	11.80
9.89	10.56	10.90	11.35	11.89
9.92	10.58	10.92	11.37	11.93
9.92	10.62	10.92	11.40	12.46

The total number of samples of food and drugs examined during the year was as follows: —

Milk,	3,712
Other articles of food,	2,971
Drugs,	544
Total,	7,227
Total expenses of collection, examination and prosecution,	$11,375 89
Average expense per sample collected,	1 57

Fines.

The amount of fines paid into the treasuries of counties, cities and towns under the provisions of the general and special laws relative to the inspection of food and drugs was as follows: —

Fines paid for Violation of the Food and Drug Acts, upon Cases entered for the Year ending Sept. 30, 1895.

Under the provisions of the laws relating to milk and milk products,	$2,652 62
Under the provisions of the laws relating to other articles of food and drugs,	242 68
Total,	$2,895 30

Expenditures

Under the Provisions of the Food and Drug Acts during the Year ending Sept. 30, 1895.

	For the Enforcement of the Statutes relating to Food and Drug Inspection.	
	Relative to Milk and Milk Products.	Relative to Other Kinds of Food and Drugs.
Salaries of analysts,	$2,700 01	$1,800 00
Salaries of inspectors,	2,400 00	1,563 32
Travelling expenses and purchase of supplies,	1,100 00	725 00
Apparatus and chemicals,	577 05	334 71
Printing,	2 40	1 60
Gas,	1 44	96
Expressage,	1 68	1 12
Legal services,	45 00	-
Sundry small supplies,	17 76	11 84
Extra services,	55 20	36 80
	$6,900 54	$4,475 35 6,900 54
Total,		$11,375 89

SAM'L W. ABBOTT,
Secretary of State Board of Health.

REPORTS OF THE ANALYSTS.

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REPORTS OF THE ANALYSTS.

Dr. S. W. Abbott, *Secretary of the State Board of Health.*

Dear Sir: — I have the honor to report the analysis of food and drugs for the year beginning Oct. 1, 1894, and ending Sept. 30, 1895.

Milk.

The number of samples of milk analyzed in the State House laboratory during the year was larger than that of any previous year, and includes all the milk collected by the three inspectors of the Board throughout the State, exclusive of that from the four western counties, the examination of which is done at Amherst.

As usual, the total solids of every sample of milk submitted to us were determined gravimetrically, and those found below 12 per cent. total solids were further analyzed for fat. The methods of analysis were the same as those employed in previous years, viz., the determination of the solids by evaporation and of the fat by means of the Babcock process.

A careful examination was also made in suspected cases for color, preservatives, etc.

The ratio of samples found to be below the standard for the year is shown to be 51.5 per cent., being nearly identical with that of the preceding year, which was 51 per cent.

The following table shows the quality of the milk by months, and the percentage of adulteration of each month, corresponding to a standard of 13 per cent. and 12 per cent. respectively: —

Quality of Milk by Months.

Months.	Total Samples Collected.	Above 13 Per Cent.	Below 13 Per Cent.	Below 12 Per Cent.	Ratio below 13 Per Cent. Standard.	Ratio below 12 Per Cent. Standard.
October,	265	120	145	43	54.7	16.2
November,	165	87	78	17	47.3	10.3
December,	225	111	114	20	50.7	8.8
January,	252	126	126	31	50.0	12.3
February,	275	131	144	43	52.4	15.6
March,	289	115	174	42	60.2	14.5
April,	241	82	159	34	65.9	14.1
May,	297	127	170	23	57.2	7.7
June,	402	127	275	79	68.4	19.6
July,	375	117	258	92	68.8	24.5
August,	370	117	253	72	68.3	19.4
September,	393	117	276	83	70.2	21.1
	3,549	1,377	2,172	579	61.2	16.3

It will be seen that under a standard of 13 per cent. throughout the entire year the ratio of samples below the standard would be 61.2 per cent., while with a 12 per cent. standard for the year the ratio would be only 16.3 per cent., so that the relative showing for the year is largely dependent on legislative enactment.

The following tables show the sources of the various samples of milk examined, apportioned among the cities, towns and suspected producers : —

Milk from Cities.

CITIES.	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.
Boston,	191	92	99	52.3	9.66	3	-
Brockton,	23	16	7	30.4	10.45	-	-
Cambridge,	383	210	173	45.2	10.27	3	-
Chelsea,	179	83	96	53.7	10.74	4	-
Everett,	121	49	72	59.5	10.84	2	4
Fall River,	84	50	34	40.4	10.60	-	-
Fitchburg,	12	11	1	8.3	9.50	3	-
Gloucester,	106	58	48	45.3	8.80	-	2
Haverhill,	13	6	7	53.8	11.18	-	-
Lawrence,	58	37	21	36.2	11.11	4	-
Malden,	130	62	68	52.3	10.60	1	-
Marlborough,	10	3	7	70.0	11.65	2	-
Medford,	130	63	67	51.5	11.10	-	1
Newburyport,	12	7	5	41.6	12.44	-	-
Newton,	92	54	38	41.3	10.52	1	-
North Adams,	13	11	2	15.3	12.08	-	-
Quincy,	44	16	28	63.6	11.15	-	-
Salem,	102	56	46	45.1	9.87	-	-
Somerville,	260	125	135	51.9	10.08	1	-
Taunton,	24	18	6	25.0	11.28	-	-
Waltham,	56	27	29	51.7	10.27	-	3
Woburn,	140	46	94	67.1	9.95	-	16
Worcester,	22	9	13	59.1	11.66	-	-
Totals,	2,205	1,109	1,096	49.7	8.80	24	26

Milk from Towns.

Towns.	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.
Arlington,	3	2	1	33.3	11.50	-	-
Braintree,	5	5	0	0.0	12.40	-	-
Brookline,	96	63	33	34.3	11.54	1	-
Canton,	23	18	5	21.7	11.87	-	-
Clinton,	12	4	8	66.6	10.10	2	-
Danvers,	6	2	4	66.6	11.42	-	-
Dedham,	53	34	19	35.8	9.96	-	-
Hopkinton,	10	4	6	60.0	12.07	-	-
Hull,	19	6	13	68.4	10.90	-	-
Hyde Park,	60	38	22	36.6	11.30	-	-
Lexington,	10	10	0	0.0	12.00	-	-
Melrose,	9	5	4	44.4	12.44	-	-
Milford,	12	7	5	41.7	11.26	-	-
Nantucket,	14	7	7	50.0	10.79	-	-
Natick,	12	8	4	33.3	11.82	-	-
Peabody,	28	4	24	85.7	7.44	-	1
Provincetown,	29	10	19	65.1	10.82	1	-
Randolph,	10	10	0	0.0	12.73	-	-
Revere,	97	47	50	51.5	11.49	1	-
Salisbury,	24	17	7	29.2	11.55	-	-
Stoneham,	96	59	37	38.5	10.25	-	-
Stoughton,	33	25	8	24.2	9.78	1	-
Ware,	12	10	2	16.6	12.25	-	-
Wareham,	31	12	19	61.3	10.37	-	-
Watertown,	26	16	10	34.6	10.65	1	-
Weymouth,	10	9	1	10.0	9.74	-	-
Winchester,	46	26	20	43.4	11.34	1	-
Winthrop,	15	8	7	46.6	11.62	-	-
Totals,	801	466	335	41.8	7.44	8	1

Milk from Suspected Producers.

Locality.	Total Samples Collected.	Above Standard	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Colored Samples.
Ashland,	5	0	5	100.0	10.80	-
Athol,	5	1	4	80.0	9.84	-
Barre,	20	14	6	30.0	11.12	-
Bedford,	52	2	50	96.1	9.92	-
Berlin,	6	0	6	100.0	11.35	-
Billerica,	5	0	5	100.0	10.87	-
Bolton,	6	0	6	100.0	11.54	-
Boylston,	10	0	10	100.0	11.14	-
Burlington,	12	12	0	0.0	12.14	-
Canton,	12	0	12	100.0	11.55	-
Danvers,	10	4	6	60.0	12.20	-
Dedham,	10	0	10	100.0	9.84	-
Deerfield,	12	1	11	91.6	6.66	-
Dover,	14	1	13	92.8	10.63	-
Faulkner,	22	0	22	100.0	10.37	-
Framingham,	7	2	5	71.4	10.24	-
Franklin,	2	0	2	100.0	9.60	-
Gardner,	15	0	15	100.0	11.53	-
Grafton,	5	0	5	100.0	11.32	-
Hardwick,	19	12	7	36.8	11.43	-
Holliston,	9	2	7	77.7	10.86	-
Leominster,	8	5	3	37.5	11.36	-
Medfield,	16	3	13	81.2	9.22	-
Medford,	12	4	8	66.6	12.33	11
Milton,	20	13	7	35.0	10.92	-
Natick,	15	2	13	86.6	11.08	-
Norwell,	3	0	3	100.0	11.93	-
Northborough,	18	0	18	100.0	10.64	-
North Brookfield,	12	0	12	100.0	9.89	-
Pembroke,	4	0	4	100.0	11.16	-
Royalston,	7	0	7	100.0	8.53	-
Sherborn,	19	4	15	78.9	10.90	-
Southborough,	8	0	8	100.0	10.49	-
Sudbury,	19	1	18	94.7	10.17	-
Stow,	36	15	21	58.3	10.96	-
Upton,	11	4	7	63.6	10.84	-
Walpole,	4	4	0	0.0	12.02	-
Waltham,	23	13	10	43.4	12.08	-
Wenham,	12	8	4	33.3	10.87	-
Westborough,	12	0	12	100.0	11.04	-
Westford,	4	0	4	100.0	9.92	-
Weston,	3	3	0	0.0	13.07	-
Totals,	524	130	394	75.2	6.66	11

Summary of the Three Preceding Tables.

	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.
Cities,	2,205	1,109	1,096	49.7	8.80	24	26
Towns,	801	466	335	41.7	7.44	8	1
Suspected producers,	524	130	394	75.2	6.66	-	11
Miscellaneous,	19	15	4	21.0	-	-	-
	3,549	1,720	1,829	51.5	6.66	32	38

The number of milk samples collected from producers was considerably larger than usual, and a much larger number of towns than usual is included in this list.

The number of colored samples found during the year is unusually large. Annatto was the favorite coloring matter employed. While in most instances the color was added to conceal evidence of watering, a number of cases were found in which the milk itself was considerably above the standard, though containing added coloring matter.

Several samples of milk were found to contain an added coal tar color. It was found to be a mixture of two or more of the orange members of the diazo compounds of aniline. A mixture of the dyes known to the trade as "Orange G" and "Fast Yellow" gives a color which is essentially identical with this milk color.

For its detection in the milk it was found sufficient to curdle about half a pint of the heated milk with acetic acid, so as to separate the casein in one mass. The whey being poured off, the orange dye, if present, is readily detected in the curd by macerating with ether for some time, preferably over night. The natural color of the milk left in the curd is entirely dissolved out by the ether, as is annatto or any of the common vegetable coloring matters, leaving the curd a pure white. The coal tar dye, on the contrary, is not dissolved out by ether, and, on pouring off the latter, the dye is readily apparent, if present, by the persistent deep yellow or orange color of the curd.

Among a number of samples of milk brought in by one of the inspectors was found a sample can containing water colored with caramel, with the addition also of common salt. This colored water, it was afterwards ascertained, was found by the inspector in an eight-quart can nearly full, among a number of milk cans in a dealer's wagon. Its obvious use was to both water and color at the same time milk delivered in small cans from house to house. This method of treating the milk at the time of its delivery was doubtless considered by the dealer as a very clever dodge, in that the milk taken from his wagon would undoubtedly be found to be of good quality.

The lowest sample of milk analyzed this year contained 6.66 per cent. total solids, of which 2.25 per cent. was fat. This was taken from a farmer, and was one of a lot of milk samples which was, with one exception, the worst lot ever analyzed by the Board.

Bearing on the question so often asked in court as to the degree of accuracy attainable in parallel analyses of the same milk, and as to the closeness of agreement in analyses of the same milk by different chemists, an opportunity was afforded during the year to practically test this point.

A certain milk dealer was suspected of having tampered with sealed samples of milk given him by an inspector to the extent of removing the milk contained in the sealed bottles delivered to him by the inspector (which milk was of poor quality) and replacing it by other milk of good quality, afterwards fixing the seals so as not to be detected, and taking the samples to an outside chemist for analysis. The wide difference in the results obtained by the outside chemist and those of the Board's analyst (amounting in one case to about 3 per cent. of milk solids) led to a second raid on the dealer by the inspector, who was instructed to make several sealed samples of each milk taken, in order that check analyses might be made by different chemists. Following is a summary of the results in percentage of total solids obtained and reported independently by three analysts on the nine samples of milk so taken: —

A,	13.10	13.11	13.02	*F*,	13.64	13.60	13.62
B,	12.60	12.54	12.50	*G*,	14.03	13.90	13.96
C,	12.74	12.76	12.78	*H*,	12.42	12.42	12.40
D,	12.84	12.77	12.78	*I*,	12.62	12.69	12.70
E,	11.42	11.43	11.46				

None of the milk samples examined during the year were found to contain any added preservative.

Condensed Milk.

The accompanying table shows the results of the analysis of as many brands of condensed milk as could conveniently be obtained. The quality of the milk used is shown to be in nearly every instance all that could be desired, and it would seem as if the popular idea that condensed milk is usually made from skimmed milk is erroneous.

The method of analysis employed, adapted from that of H. B. Cornwall, consisted in first weighing out 40 grammes of the thoroughly mixed sample and making up to 100 cubic centimeters with water. Portions of this solution were taken for the various determinations, as follows: —

Total Solids. — An aliquot part of the above 40 per cent. solution was further diluted with an equal amount of water, and 5 cubic centimeters of the diluted mixture (corresponding to 1 gramme of the condensed milk) was evaporated, dried and weighed in a platinum dish.

Ash. — The residue from the total solids as above obtained was burned and weighed.

Fat. — Five cubic centimeters of the 40 per cent. solution (corresponding to 2 grammes of the condensed milk) was absorbed by a coil of filter paper which was dried in an air oven at 100° C., and the fat extracted by ether in a Soxhlet extractor.

Proteids. — Five cubic centimeters of the 40 per cent. solution was further diluted to about 40 cubic centimeters, and just enough of a very weak solution of copper sulphate was added to precipitate the albuminoids, which slowly settled, leaving a perfectly clear solution of the whey, free from copper. The precipitate was filtered through a weighed filter, washed and afterwards dried in the air oven and weighed. The filter with the dried precipitate was then incinerated in a porcelain crucible, and the weight of the ash minus that of the dried precipitate gave the weight of the proteids and fat. Deducting the percentage of fat, already obtained, from that of the proteids and fat, left the percentage of proteids.

Milk Sugar. — The filtrate and the washings from the preceding operation were made up to 100 cubic centimeters with water, and the amount of reducing sugar obtained volumetrically by Fehling's solution was reckoned as milk sugar.

Cane Sugar. — This was obtained by difference, deducting the total *milk* solids (milk sugar + proteids + fat + ash) from the total solids first obtained.

Condensed Milk.

Inspector's Number.	Brand.	Total Solids.	Water.	Milk Solids.	Cane Sugar.	Milk Sugar.	Proteids.	Fat.	Ash.	Fat in Original Milk.*	Number of Times Condensed *	Price Paid per Can.
19089,	Anglo Swiss,	75.30	24.70	36.03	39.27	14.13	9.45	10.80	1.65	3.98	2.7	.18
19088,	Standard,	72.37	27.63	35.78	36.59	16.75	7.40	9.63	2.00	3.42	2.8	.10
20985,	Baby,	75.52	24.48	33.26	42.20	12.18	7.27	11.95	1.86	5.21	2.3	.18
19079,	Rose,	72.05	27.95	32.42	39.63	11.51	8.33	10.88	1.70	4.69	2.3	.13
19128,	Bell,	70.32	29.68	32.77	37.55	13.96	7.55	9.44	1.82	3.76	2.5	.09
9707*f*,	Sweet Clover,	72.82	27.18	29.32	43.50	12.18	5.95	9.68	1.51	4.58	2.1	.10
13*g*,	J. B. Smith,	69.15	30.85	32.65	36.50	13.84	7.84	9.25	1.72	3.67	2.5	-
19087,	Tip Top,	70.40	29.60	34.35	36.05	12.73	9.39	10.54	1.69	4.11	2.6	.09
19252,	Challenge,	70.50	29.50	32.22	38.28	11.43	8.32	10.80	1.67	4.68	2.3	.10
19086,	Rose,	75.30	24.70	39.76	35.54	20.06	7.52	10.23	1.95	3.18	3.0	.10
19091,	Gail Borden Eagle,	71.96	28.04	30.00	41.96	11.55	8.78	8.25	1.42	3.52	2.3	.18
907*g*,	Sachem,	70.44	29.56	34.65	35.79	15.43	8.37	9.28	1.57	3.40	2.7	.08
19090,	Leader,	74.56	25.44	29.94	44.62	12.69	5.96	9.72	1.57	4.47	2.2	.09
9927*f*,	Sweet Clover,	71.70	28.30	27.52	44.18	9.71	7.00	9.52	1.29	5.47	1.9	.10
6351*g*,	Magnolia,	70.89	29.11	31.44	39.45	11.75	7.58	10.43	1.68	4.61	2.3	.10
4059*g*,	Rival,	74.04	25.96	30.85	43.19	14.69	6.42	8.42	1.32	3.49	2.4	.10
4679*g*,	Buttercup,	65.90	34.10	26.98	38.92	7.05	9.25	9.18	1.50	4.77	1.9	-
6765*g*,	Russel,	74.59	25.41	28.33	46.26	10.53	8.31	8.05	1.44	3.69	2.2	-
9717*f*,	Ten Cent,	75.41	24.59	35.42	39.99	13.40	9.83	10.61	1.58	3.97	2.7	.10
21774,	Pine Tree,	70.50	29.50	32.20	38.30	13.13	7.67	9.91	1.49	4.13	2.4	.10

21764,	Dime,	71.12	28.88	32.49	38.63	13.45	9.42	8.22	1.40	3.15	2.6	.08
21766,	Daisy,	72.50	27.50	33.54	38.96	14.25	8.92	9.05	1.32	3.43	2.6	.10
21760,	Tip Top,	75.25	24.75	35.72	39.53	18.93	7.39	7.80	1.60	2.59	3.0	.10
19093,	Nestle's Swiss,	76.15	23.85	35.13	41.02	14.25	8.51	10.70	1.67	4.07	2.6	.17
21763,	Milk Maid,	72.42	27.58	29.65	42.77	7.05	8.90	12.34	1.36	6.04	1.9	.15
21768,	Standard,	69.49	30.51	28.95	40.54	10.09	9.09	8.25	1.52	3.70	2.2	.10
21767,	Gail Borden Eagle,	72.73	27.27	34.36	38.37	13.84	8.39	10.35	1.78	4.00	2.6	.18
21762,	Rose,	73.35	26.65	31.37	41.98	11.55	7.50	10.82	1.50	4.88	2.2	.12
21765,	Anglo Swiss,	75.43	24.57	34.53	40.90	14.44	7.92	10.52	2.65	4.07	2.6	.18
19078,	Tip Top,	71.82	28.18	34.44	37.38	13.34	9.06	10.47	1.57	4.06	2.6	.10
7035*g*,	Thistle,	71.32	28.68	28.77	42.55	10.94	8.47	8.03	1.33	3.60	2.2	-
2950*f*,	Magnolia,	72.10	27.90	34.06	38.04	16.58	8.51	7.45	1.52	2.60	2.8	-
5118*f*,	Buttercup,	69.00	31.00	29.36	39.64	11.92	6.90	9.13	1.41	4.19	2.2	-

* Assuming a standard of 9.3 per cent. for solids not fat.

Butter.

Of 191 samples 186 proved to be genuine.

The Zeiss refractometer has been largely used in quickly detecting the admixture or substitution of margarine. Samples that the refractometer indicated as containing margarine were analyzed by the Reichert process in confirmation.

Cheese.

Thirteen samples were found of good quality. One sample of skim-milk cheese was found.

Lard.

The analysis of lard both in this country and abroad has recently attracted much attention, and many methods have been devised for detecting admixture of beef fat and cotton-seed oil, the chief adulterants. The tests chiefly relied upon in this laboratory have been the following: —

Reaction with Strong Acid (Sulphuric or Nitric.) — Genuine lard and beef tallow usually give but slight coloration, while mixtures of cotton-seed oil invariably give a red-brown color, more or less intense in proportion to the amount of cotton-seed oil present.

A genuine lard will, however, occasionally be found to give a strong color with acid.

The Microscopic Examination of the Stearin Crystals Separated from an Ether-Alcohol Solution. — The characteristic crystalline forms of lard and tallow stearin are shown in figs. 1, 2 and 3.

The Hehner Modification of the Bechi Nitrate of Silver Test. — A small amount of the sample is shaken with half its bulk of a standard alcoholic solution of nitrate of silver, made very slightly acid with nitric acid. The vessel containing this mixture is then immersed in boiling water for fifteen minutes. With proper precautions the presence of cotton-seed oil is indicated by a strong reduction of the silver, while pure lard or tallow in the absence of cotton-seed oil causes no appreciable reduction.

The Refractometer Reading. — The refractometer used is the Zeiss instrument, in which the degree of refraction of a reflected beam of light which passes obliquely through a thin film of the fat

is read on an arbitrary scale. A constant temperature by means of a circulation of heated water is maintained and its degree is noted. The refracting degree of cotton-seed oil is about 8.9 in excess of the standard refraction of lard, while that of tallow is about 3.8 less than the standard. This is shown by samples H and I in the following table.

The readings are quickly and easily taken, and, in connection with the positive Bechi test for cotton-seed oil and the crystallization test for beef stearin, the refractometer is of great value.

It will be noted that adulteration of lard with cotton-seed oil alone is indicated by an abnormally high refractometer number, while the presence of tallow will result in an abnormally low refraction. But both adulterants may be present and a normal refraction result. In such a case the positive detection of one of them, such as the cotton-seed oil by the Bechi test, will indirectly show the presence of the other (tallow), and this indirect proof will be confirmed by crystallization.

The Iodine Absorption Number.—This is perhaps the most important of all the tests, although its results are in general prefigured by the refractometer. By it is meant the percentage of iodine which a sample of fat will absorb.

As may be seen in the following table, cotton-seed oil (H) will absorb about 108 per cent. of its weight of iodine, while beef fat (I) will absorb but about 37 per cent.

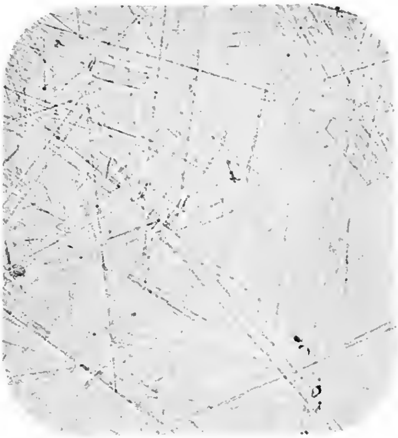
Table showing Analysis of Samples, Illustrating Types of Lard and its Substitutes.

	Acid Reaction.	Crystallization.	Bechi Reaction.	Refractometer.			Iodine Number.	Conclusion.
				Temperature.	Index.	Variation from Standard.		
A	Slight color,	Lard,	None,	42.3	49.7	+0.1	58.1	Lard.
B	Red,	Lard,	None,	42.	50.	+0.2	59.9	Lard.
C	Slight color,	Lard,	None,	41.5	50.1	+0.0	58.7	Lard.
D	Slight color,	Lard,	None,	42.8	50.	+0.6	63.7	Lard.
E	Slight color,	Lard,	None,	41.3	51.	+0.8	64.6	Lard.
F	Slight color,	Lard,	None,	42.	50.5	+0.7	64.8	Lard.
G	Slight color,	Lard,	None,	42.	49.7	—0.1	56.4	Leaf lard.
H	Very slight color,	Tallow,	None,	50.	41.2	—3.8	37.3	Beef tallow.
I	Deep brown, red,	Few small bunches,	Deep color,	42.	58.7	+8.9	108.	Cotton-seed oil.
J	Red,	Lard,	Deep color,	43.	50.5	+1.3	69.5	Lard and cotton-seed oil.
K	Very slight color,	Lard and tallow,	None,	43.	48.5	—0.7	55.2	Lard and beef tallow.
L	Deep brown,	Lard,	Deep color,	43.5	51.	+1.1	71.4	Lard and cotton seed oil.
M	Red,	Lard,	Deep color,	43.7	50.1	+1.3	66.7	Lard and cotton seed oil.
N	Red,	Lard and tallow,	Deep color,	43.5	49.1	+0.3	54.7	Lard and beef tallow and cotton-seed oil.

PHOTO-MICROGRAPHS.

Enlargement, 160 diameters.

1



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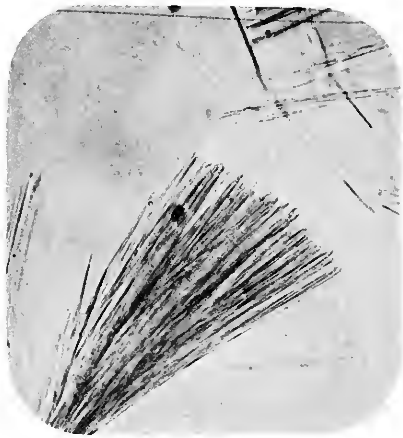

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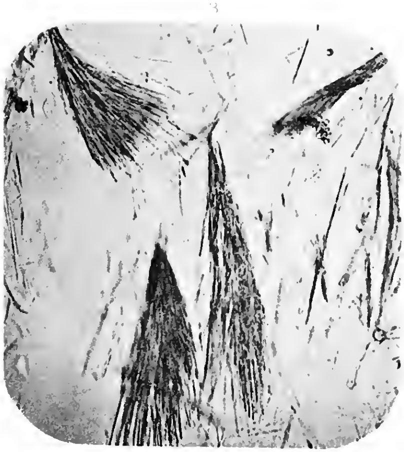

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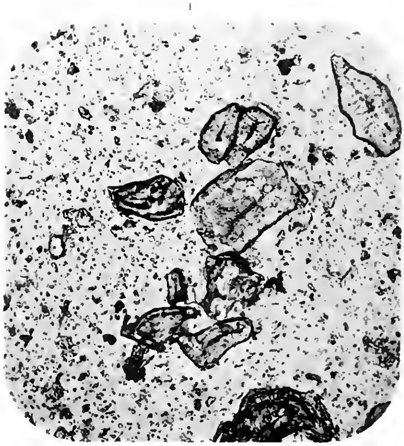

1. Crystals of pure Leaf Lard Stearin.
2. Crystals of pure Back Lard Stearin.
3. Crystals of pure Beef Tallow Stearin.
4. Ground Pepper adulterated with ground Olive Stone.

Samples A, B and C give reactions corresponding to normal pure lard. D, E and F show somewhat high refractometer and iodine numbers but give no direct reaction for cotton-seed oil by the Bechi test. G, although showing low iodine and refractometer numbers, gives no evidence of the presence of tallow by crystallization. In fact, the crystals from this sample proved, under all circumstances, to be most clearly typical of pure lard, — broad and flat plates with obliquely cut ends.

This sample was, in fact, a pure leaf lard. It has been our experience that a stiff, strictly pure leaf lard, which both by its consistency and by its low iodine and refractometer numbers might suggest the presence of beef fat, shows, on crystallization, much more definitely characteristic lard stearin than does a whole hog lard, whose iodine and refractometer numbers are more nearly the normal standard.

In distinction from such a leaf lard, a sample which may have a similar consistency and iodine and refractometer numbers, but which is composed of a whole hog lard of a comparatively high iodine number, together with beef fat, gives unmistakable proof of its adulteration by its crystallization.

Fig. 1 shows the crystalline form of pure leaf lard stearin; Fig. 2, of whole hog lard stearin; Fig. 3, of beef tallow stearin.

The adulteration of lard with tallow and cotton-seed oil is wholly unobjectionable as far as the wholesomeness of the compound is concerned. It is objectionable only on the ground of fraud, and is legally permissible provided the mixture is properly labelled.

Olive Oil.

Forty-two samples proved to be genuine and 9 were found to be adulterated with cotton-seed oil.

Vinegar.

Thirty-two samples were of standard quality and 32 were inferior.

These figures indicate great carelessness as well as fraud in putting up this standard article.

The adulteration of vinegar is chiefly practised outside of Boston, in which city the vigorous enforcement of the law has resulted in the practical suppression of the sale of an inferior article. The report of the inspector of milk and vinegar for 1894, states that, of

938 samples examined, but few failed to conform to the statute requirements, and that dealers in spurious cider vinegar have abandoned Boston as a field of operations. It is to be hoped that a vigorous enforcement of the vinegar law throughout the State will result in driving such dealers out of the Commonwealth.

The definite standards fixed by statute render conviction under the vinegar law comparatively easy.

SPICES.

As usual, a large number of ground spices have been examined microscopically and chemically for adulteration.

One thousand and nineteen samples were found pure and 166 adulterated. The extent of adulteration varied from a trace up to 90 per cent.

Spices are very largely adulterated in other States, where a pure food law is not enforced. In this State, when the work of inspection was begun, 65 per cent. of the samples submitted were found to be adulterated. The great and nearly uniform decrease of adulteration of spices since that time may fairly be credited in large part to systematic and persistent public food inspection. The legalized sale of adulterated goods under the name of compounds still continues to a limited extent, with more or less attempt to conceal the real nature of the articles ; but there appears to be a healthy and growing demand for guarantees of strict purity among small dealers and consumers.

Allspice.

Ninety-eight genuine, 4 adulterated. The adulterants found were wheat and nutshells.

Cassia.

One hundred and forty-six genuine, 2 adulterated. The adulterants found were wheat, corn, nutshells and turmeric.

Cayenne.

Seventy-three genuine, 34 adulterated. The adulterant found was chiefly corn, but admixtures of wheat, rice, turmeric and salt were also found.

Cloves.

One hundred and ninety-three genuine, 15 adulterated. The adulterants found were wheat, corn, rice, nutshells, turmeric and clove stems.

Ginger.

One hundred and thirty-four genuine, 22 adulterated. The adulterants found were wheat, corn and turmeric. The fancy for deeply coloring this spice with a liberal mixture of turmeric is hardly less frequently met with than in the case of mustard.

Mace.

Sixteen genuine.

Mustard.

One hundred and twenty-seven genuine, 71 adulterated. The adulterants found were wheat, corn, rice, turmeric, cayenne and gypsum. The "terra alba" was found in one sample to the extent of 21 per cent.

Nutmeg.

Six genuine.

Pepper.

Two hundred and twenty-six genuine, 17 adulterated. The adulterants found were corn, wheat, rice, ginger, cayenne, grains of paradise, nutshells and buckwheat. Several samples were found to be largely adulterated with woody stone cells, identical with those of the olive stone. Fig. 4 shows the microscopic appearance of one of these samples. This adulteration has been reported found in other localities but it has not been found here before.

COFFEE.

Seventy-nine genuine, 19 adulterated. The adulterants found were peas and pea hulls, chicory, wheat, straw, sticks, glass and artificial grains made of a roasted wheat mash.

CREAM OF TARTAR.

Three hundred and sixty-four genuine, 12 adulterated. The adulterants found were starch (wheat and corn), acid phosphate of calcium and gypsum. One sample contained 85 per cent. of the last-named substance.

HONEY.

Forty-one genuine, 2 adulterated. The adulterant found was glucose syrup.

MOLASSES.

Two hundred and twelve genuine, 13 adulterated. The adulterant found was glucose syrup.

Maple Sugar.

Forty genuine, 7 adulterated. The admixture or substitution of a crude brown cane sugar for maple sugar is of frequent occurrence in the spring, when "maple sugar" is to be found in nearly every market or fruit stand, grocer's or confectioner's shop. There is, of course, no valid objection to the sale of a cheap brown sugar moulded into cakes, provided it is not sold as maple sugar and at its comparatively high price.

It is not a difficult matter to distinguish between maple sugar and the "brown sugar" of the grocers' shops by appearance, by odor, particularly when boiled with water, and by taste. Chemically the distinction between the two is facilitated by the fact that the juice of the sugar cane contains from 0.15 to 2 per cent. of albuminous matters, while the sap of the maple tree contains but about 0.01 per cent. of albuminoids.

Notwithstanding the fact that the dilution of the maple sap is greater than that of the cane juice, the fact remains that the ratio of albuminous matters to total solids of the cane juice is greater than that of the maple sap.

The greater sulphur contents of the grocers' brown sugar, which may readily be determined, is apparently due to this cause.

The potash in the ash of sugar from the cane has always been accompanied in our experience by a notable proportion of sodium salt, while the soluble ash of maple sugar has proved nearly pure potash.

Maple Syrup.

Twenty-seven genuine, 3 adulterated. The adulterant found was glucose syrup.

Tea.

Eighty-five genuine, 6 inferior. Two samples of compressed tea tablets were examined, with the following widely different results: —

	A	B
Total hot water extract,	19.5	54.4
Water,	5.05	8.7
Insoluble ash,	4.45	2.6
Soluble ash,	3.45	2.8
Theine,	–	2.25

Food Preservatives.

Samples of canned, bottled and dried foods of various kinds have been examined for artificial preservatives. Among those containing borax or boracic acid were samples of shredded codfish, oysters and clam juice.

Notable amounts of salicylic acid were found in many brands of tomato catsup, grape juice, strawberry jam, mince and apple preparations for pies, lager beer and fruit syrups.

A salt sold on the fish wharves as a "fish preservative" proved to be a mixture of common salt and borax. An "oyster preservative" proved to be a mixture of salt and boracic acid.

Egg Foods.

Samples of egg foods were examined, with the following results. They purported to be the equivalents in all respects of fresh eggs. A ten-cent package of sample A, for instance, weighing about two ounces, is announced to be equal to twelve eggs, whether of the domestic fowl or not is not specified.

	A	B	C
Protein,	16.94	18.72	48.15
Fat,	3.43	3.40	40.56
Water,	6.71	7.01	5.95
Corn starch, salts and coloring matter,	72.92	70.87	5.34

Another sample was found to contain 29.9 per cent. of sugar.

It will be noted that the composition of sample C corresponds closely to the analysis of dried eggs, which contain of proteid, 54 per cent.; fat, 40 per cent.; salts, 5 per cent.

A sample of barberry preserve which had been boiled in a copper kettle was found to contain .003 grams of copper per 100, calculated as the sulphate.

Samples of extract of vanilla were examined by Merck's method. Ten were found to contain from .87 to 2.23 grams of vanillin per litre. Two others were found to contain coumarin.

Samples of fruit jellies were found to be composed of a cheap cider jelly variously modified by neutralizing and artificially coloring and flavoring to represent currant, blackberry, etc.

Thirty-seven samples of granite-ware dishes were examined. They comprised a great variety of articles, a large number of which were for use as cooking utensils. When thus used, particularly with acid contents, the metallic constituents of the glaze are dissolved quite readily. Of these cooking utensils the glaze was found in 23 instances to contain notable quantities of antimony and in 1 instance a small trace of arsenic; 10 contained tin. The glaze of 12 was found to be properly composed of harmless silicates.

A considerable number of samples of a miscellaneous nature have been examined. Among them may be mentioned samples of tea, meat, etc., which were reported to have caused symptoms of poisoning. On examination they gave negative results.

Various pudding preparations, such as "Kustard" and "Desertine," were found to be essentially corn-starch, sweetened, colored and flavored.

A sample of "phosphated gelatine" proved very strongly acid, containing no less than 3.42 per cent. of phosphoric acid.

Summary of Food Statistics.

Foods.	Genuine.	Adulterated.	Total.	Per Cent. of Adulteration.
Allspice,	98	4	102	3.9
Butter,	186	5	191	2.6
Canned goods,	13	25	38	65.8
Cassia,	146	2	148	1.3
Cayenne,	73	34	107	31.8
Cheese,	13	0	13	0.0
Cloves,	193	15	208	7.2
Coffee,	79	19	98	19.4
Confectionery,	61	1	62	1.6
Cream of tartar,	364	12	376	3.2
Ginger,	134	22	156	14.1
Honey,	41	2	43	4.6
Lard,	17	8	25	32.0
Mace,	16	0	16	0.0
Maple sugar,	40	7	47	14.9
Maple syrup,	27	3	30	10.0
Miscellaneous,	143	279	422	66.1
Molasses,	212	13	225	5.3
Mustard,	127	71	198	35.9
Nutmeg,	6	0	6	0.0
Olive oil,	42	9	51	17.7
Pepper,	226	17	243	7.0
Syrups,	5	6	11	54.5
Tea,	85	6	91	6.6
Vinegar,	32	32	64	50.0
Total,	2,379	592	2,971	19.9

Drugs.

Acidum Benzoicum: 4 standard.

Acidum Hydrobromicum Dilutum: 1 standard.

Acidum Tannicum: 12 standard.

Æther: 5 standard; 8 inferior, containing too much alcohol.

Alcohol: 6 standard.

Aqua Ammoniæ: 10 standard; 1 inferior, containing too little anhydrous ammonia.

Aqua Chlori: 2 inferior; 1 sample contained no trace of chlorine.

Aqua Destillata: But little care appears to be taken to supply a good article. The amount of solid matters per 100,000 parts of water may be seen by the following table of results of samples examined: —

Distilled Water (Parts of Solids per 100,000 of Water).

0.0	4.0	6.5	7.2	9.0	18.3
0.0	4.2	6.5	7.5	9.0	20.0
0.3	4.5	6.5	7.5	9.1	38.5
0.8	4.5	6.5	8.0	11.9	120.0
3.0	6.2	6.6	8.5	12.8	

Aqua Hydrogenii Dioxidi: 2 standard; 2 inferior. The samples which failed to meet the Pharmacopœial requirements contained but 57.5 per cent. and 25 per cent. of the proper amount of peroxide.

Argenti Nitras: 7 standard; 1 inferior, containing a sodium salt.

Bismuthi Subcarbonas: 1 standard.

Bismuthi Subnitras: 7 standard; 2 inferior, containing traces of arsenic.

Calx Chlorata: 2 standard; 2 inferior. One of these samples contained but 12 per cent. of available chlorine. The Pharmacopœia demands 35 per cent.

Cerii Oxalas: 3 standard.

Chloroformum: 8 standard; 1 inferior.

Creta Præparata: 3 standard.

Extractum Glycyrrhizæ: 2 standard; 23 inferior, containing considerable amounts of corn starch.

Glycerinum: 2 standard.

Iodoformum: 1 standard.

Lycopodium: 1 standard.

Magnesii Sulphas: 2 standard.

Morphinæ Sulphas: 1 standard.

Oleum Ætheris: 1 inferior, consisting chiefly of amyl alcohol.

Oleum Limonis: 3 standard; 1 inferior.

Oleum Morrhuæ: 5 standard.

Oleum Ricini: 10 standard.

Potassii Iodidum: 1 standard.

Pulvis Glycyrrhizæ: 1 standard.

Pulvis Glycyrrhizæ Compositus: 1 inferior.

Pulvis Opii: The Pharmacopœia demands from 13 to 15 per cent. of morphine. Samples gave on analysis percentages of morphine as follows: —

17.3	15.6	14.7	14.2	13.4
16.5	15.0	14.6	14.1	

Pulvis Rhei: 3 standard.

Spiritus Ætheris Compositus: 6 standard; 8 inferior, containing little or no heavy oil of ether, upon which the virtue of the drug depends.

Spiritus Ætheris Nitrosi: but very few samples showed even an approximation to the Pharmacopœial requirement in contents of ethyl nitrite. This drug cannot be properly kept unless in small, securely sealed bottles, away from the light, and even so it loses its strength in the course of years. Apparently but little care is exercised by druggists to observe these necessary precautions.

Percentages of the Required Amount of Ethyl Nitrite referred to the Pharmacopœial Standard (100 per cent.) contained in Samples of Spiritus Ætheris Nitrosi.

90	69	47	30	8
90	69	45	28	6
90	67	44	27	5
85	66	44	25	5
83	65	43	25	4
82	65	42	23	3
79	63	42	21	3
77	60	41	20	3
77	60	41	20	3
71	60	41	19	2
70	60	38	19	2
70	58	36	18	1
70	56	36	16	1
70	52	34	11	1
70	47	33	10	

Spiritus Frumenti: 1 standard; 6 inferior, as shown below*:—

Alcohol (by Weight).	Extract.	Alcohol (by Weight).	Extract.
44.55,	3.24	42.48,	0.48
44.24,	0.74	37.22,	0.16
42.95,	1.00	37.17,	0.20
42.86,	0.54		

The high extract is due chiefly to added sugar.

Tinctura Iodi: 33 standard; 37 inferior, containing too little iodine.

Tinctura Opii: the Pharmacopœia demands from 1.3 to 1.5 per cent. of morphine.

* The Pharmacopœial standard requires 44 to 50 per cent. of alcohol by weight, and not more than 0.25 per cent. of extract.

The samples analyzed contained the following percentages of morphine: —

1.63	1.26	1.14	1.00	0.94	0.84
1.50	1.25	1.11	0.98	0.94	0.82
1.48	1.23	1.08	0.98	0.93	0.78
1.43	1.23	1.08	0.97	0.91	0.76
1.37	1.23	1.07	0.96	0.90	0.68
1.35	1.18	1.05	0.96	0.89	0.67
1.35	1.16	1.04	0.96	0.89	0.53
1.28	1.15	1.03	0.95	0.88	0.43
1.27	1.15	1.00	0.95	0.88	
1.26	1.15	1.00	0.95	0.84	

Sapo: The Pharmacopœia prescribes a limit of 36 per cent. of water and tests by which an excess of free alkali and the presence of animal fats, which are prohibited, may be determined. The agreement of the samples examined with these requirements may be seen from the following table: —

SAMPLE.	Water.	Excess of Free Alkali.	Presence of Animal Fats by the Pharmacopœial Test.
1,	7.4	Slight excess.	None.
2,	3.6	None.	None.
3,	4.1	Much excess.	None.
4,	10.8	Much excess.	None.
5,	7.1	None.	Present.
6,	9.0	None.	Present.
7,	7.1	None.	Present.
8,	5.9	None.	Present.
9,	9.8	Much excess.	Present.
10,	6.4	Much excess.	Present.
11,	6.4	Much excess.	Present.
12,	5.0	None.	Present.
13,	9.4	None.	None.
14,	9.1	None.	None.
15,	5.4	None.	Present.
16,	7.4	Slight excess.	Present.
17,	11.2	None.	None.
18,	6.2	None.	None.
19,	15.0	Much excess.	None.
20,	6.7	Slight excess.	Present.
21,	14.8	Slight excess.	Present.
22,	7.0	None	Present.
23,	8.3	Much excess.	Present.
24,	27.0	Slight excess.	Present.
25,	5.5	Slight excess.	Present.
26,	6.0	Slight excess.	Present.
27,	9.7	Much excess.	Present.
28,	7.5	Slight excess.	Present.
29,	10.6	Slight excess.	Present.
30,	4.9	Much excess.	None.
31,	2.4	None.	Present.
32,	12.2	None.	None.
33,	5.8	None.	None.

Unguentum Hydrargyri: the Pharmacopœia demands 50 per cent. of mercury. The percentages of mercury found in the samples examined were as follows: —

60	51	35	32	23
57	49	34	31	20
52	48	33	30	20
52	47	33	30	8.9

A sample of unguentum zinci oxidi was found to be composed of 10.5 per cent. of oxide of zinc mixed with plain lard. The Pharmacopœia demands 20 per cent. of the zinc salt to be mixed with benzoated lard.

Vinum Album: 12 samples, all inferior, as shown by the following figures: —

Alcohol (by Weight).	Extract.	Alcohol (by Weight).	Extract.
19.17, ...	4.70	15.17, ...	5.90
18.85, ...	5.14	15.06, ...	6.00
17.15, ...	4.14	14.64, ...	7.29
17.00, ...	6.46	13.54, ...	7.96
15.47, ...	6.00	13.41, ...	7.00
15.45, ...	7.50	13.03, ...	6.00

The Pharmacopœia demands 10 to 14 per cent. of alcohol and 1.5 to 3 per cent. of solid extract. The high extract was due chiefly to added sugar.

Vinum Rubrum: 12 samples, all inferior, as follows: —

Alcohol (by Weight).	Extract.	Alcohol (by Weight).	Extract.
18.08, ...	11.44	15.00, ...	12.20
17.00, ...	10.15	14.91, ...	13.76
16.92, ...	11.49	14.09, ...	15.03
16.62, ...	13.59	13.69, ...	10.42
16.15, ...	13.04	12.62, ...	10.50
15.17, ...	10.09	11.31, ...	11.99

The Pharmacopœia demands 10 to 14 per cent. of alcohol and 1.6 to 3.5 per cent. of solid extract. As a rule port wine contains a large amount of added sugar.

Several samples of Mme. Ruppert's face bleach have been examined and all were found to contain corrosive sublimate to the extent of about 27 grains per 8 ounce bottle. The bottles were provided with the poison labels required by statute, but they were pasted on the bottoms of the bottles, where they are fairly certain to escape the notice of the average purchaser.

A sample of "Perry's Freckle Lotion" was found to contain 39 grains of the same poison per 8 ounce bottle.

A "Recamier Balm" was found to consist essentially of zinc oxide suspended in water with a trace of corrosive sublimate.

An "Excelsior Hair Tonic" consisted essentially of a bay rum containing quinine.

A sample of "Pulmonine" was found to contain 16 per cent. of alcohol by volume.

A "Coca-Kola" preparation contained caffein, cocain, sugar and tartaric acid.

"Hunyadi Granules" were found to consist essentially of tartaric acid and bicarbonate of soda.

"Vichi Granules" were of the same composition.

Summary.

	Genuine.	Adulterated.	Total.
Milk,	1,720	1,829	3,549
Food not milk,	2,379	592	2,971
Drugs,	212	332	544
Total,	4,311	2,753	7,064

Respectfully submitted,

CHARLES P. WORCESTER.

PROFESSOR GOESSMANN'S REPORT.

The whole number of samples of milk obtained and examined in the four western counties during the year was 245, of which number 60, or 24.5 per cent., proved to be below the standard.

It would be fair, however, to exclude from this number 12 samples which were obtained in West Deerfield from suspected producers, of which number 11 were found to be below the standard. Three of this number were taken from one dairy, and the results of analysis showed the following figures: 8.69, 7.44 and 6.66 per cent. of total solids respectively, the latter being the lowest taken during the year, and representing about 50 per cent. of added water. This man was promptly convicted and fined.

With these exceptions the percentage of adulterated samples in milk taken under the usual conditions of sale was 21, or a trifle less than that of 1894.

The ratio of adulteration for the past ten years shows a fairly uniform quality, the figures being as follows: —

Year.	Per Cent. of Adulteration.	Year.	Per Cent of Adulteration.
1886, ...	20.0	1891, ...	18.4
1887, ...	10.5	1892, ...	19.8
1888, ...	15.7	1893, ...	20.3
1889, ...	17.7	1894, ...	21.3
1890, ...	22.6	1895, ...	21.0

Mean ratio, ten years, 18.9 per cent.

These figures are the result of examination of 2,407 samples, of which 456 were below standard.

The following summary embraces the samples of milk obtained during the year in cities and towns west of Worcester County.

The results of analyses were as follows: —

Whole number examined,	245
Number above standard,	185
Number below standard,	60
Percentage below standard,	24.5
Number samples skimmed milk,	11

Chicopee.

Number of samples,	22
Number above standard,	18
Number below standard,	4
Percentage below standard,	18.2
Skimmed milk,	3

Holyoke.

Number of samples,	58
Number above standard,	47
Number below standard,	11
Percentage below standard,	19.0
Skimmed milk,	5

Northampton.

Number of samples,	17
Number above standard,	17
Number below standard,	0
Percentage below standard,	0
Skimmed milk,	2

Pittsfield.

Number of samples,	16
Number above standard,	13
Number below standard,	3
Percentage below standard,	18.8
Skimmed milk,	–

Springfield.

Number of samples,	44
Number above standard,	33
Number below standard,	11
Percentage below standard,	25.0
Skimmed milk,	1

The results in the towns were as follows : —

	Total.	Above Standard.	Below Standard.	Percentage Below Standard.
Greenfield,	15	10	5	–
North Adams,	14	12	2	–
South Hadley,	1	1	–	–
Ware,	32	24	8	–
West Deerfield,	12	1	11	–
Westfield,	14	9	5	–
	88	57	31	35.2

C. A. GOESSMANN,
Analyst.

AMHERST, MASS.

REPORT

UPON THE

Production and Use of Antitoxin.

REPORT UPON THE PRODUCTION AND USE OF ANTITOXIN.

In the last annual report of the State Board of Health (p. cvii) brief reference was made to the work of the Board which had been undertaken for the purpose of providing a supply of antitoxin for general use in reducing as far as possible the fatality from diphtheria in Massachusetts. The saving of human life, which had been claimed by Dr. Roux in his report upon this subject at the International Congress of Hygiene at Buda Pesth in 1894, and the similar results elsewhere attained on both sides of the Atlantic, were apparently demonstrated in so convincing a manner as to warrant the adoption of antitoxin both as a therapeutic and preventive remedy for general use. Hence the Board, acting under the provisions of the statutes requiring it to "take cognizance of the interests of health and life among the citizens of the Commonwealth," and believing it possible to reduce the fatality and consequently the death rate from diphtheria, not only by recommending the use of this measure for the purpose, but also by providing the material for such use, established in October, 1894, a laboratory for the production of antitoxin, and appointed Dr. J. L. Goodale of Cambridge to superintend the work of its preparation. The scope of this laboratory was soon afterward enlarged, so as to embrace general bacteriological work.

Dr. Goodale entered upon the work with enthusiasm, and the successful operation which was thus secured was largely due to his earnest devotion to this work. Since, however, it soon became necessary to provide for additional bacteriological work on a larger scale, Dr. Theobald Smith, chief of the Division of Pathology of the Bureau of Animal Industry at Washington, D. C., was appointed as pathologist of the Board, to take charge of this department.

After the necessary preliminary steps had been taken toward securing a continuous supply of antitoxin (providing the stables, purchasing the horses, preparing and injecting the toxine, etc.), the first quantity of antitoxin of a sufficient strength for use in the preventive treatment of diphtheria was offered for distribution March, 1895, and the following circular was then published and distributed to boards of health throughout the State: —

Commonwealth of Massachusetts.

Diphtheria Antitoxin.

[*A Circular of the State Board of Health.*]

State House, Boston, March 25, 1895.

The investigations of Behring and Roux with reference to the value of serum-therapy in the treatment of diphtheria, and the later experience of its use in diminishing the mortality from this disease, are widely known and fully understood.

The State Board of Health, in accordance with its organic purpose as defined in the statutes, having in view the "interests of health and life among the citizens of the Commonwealth," and recognizing the value to the people of any agent which will measurably prevent the ravages of a disease capable of destroying more than a thousand of lives annually in Massachusetts and of causing suffering which cannot be expressed numerically, has prepared a supply of antitoxin, for the benefit, primarily, of such communities in this State as find it difficult or impracticable for any reason to supply themselves with the new agent from reliable sources.

Great care has been exercised in the preparation of this supply to fulfil the most exacting technical requirements for obtaining a pure and trustworthy product, and the tests of its strength have shown satisfactory results.

The Board does not propose to offer it for sale, but its gratuitous distribution will be under strict conditions designed to prevent abuse and waste and to obtain the most beneficial fruits. Each bottle is marked with a number and the date of the preparation of its contents. No antitoxin will be issued except upon a pledge that a full statement of the observed effects of its use will be returned to the Board at the termination of the case. In all instances possible a bacterial diagnosis will be insisted upon. The Board desires to emphasize the importance of using such appliances only as are adapted to the proper administration of the remedy, of remembering that experience has demonstrated that antitoxin is most useful in the earliest stages of a diphtheritic attack, and of realizing that trained medical skill is required to administer it successfully.

A blank form for the report and a detailed statement of instructions as to methods will accompany each bottle of the antitoxin serum.

For the needs of persons living within twenty-five miles of Boston, it will be required, for the present, that personal application at the office of the Board shall be made by the attending physician in the diphtheria case, or by some person authorized by him. For the convenience of more distant parts of the State, local agencies at public hospitals or municipal health offices will probably be established by the Board in accessible centres.

The office of the Board (Room 141, State House Extension) is open each week-day, except Saturday, from 9 A.M. to 5 P.M., and on Saturday from 9 A.M. to 2 P.M.

Sam'l W. Abbott, *Secretary.*

As a matter of convenience, therefore, the time embraced in this report is made to include the full year ending with March 31, 1896, since the general distribution of antitoxin by the Board may be considered as beginning about one year earlier than that date, although a few vials were issued during the last week of March, 1895.

Diphtheria usually prevails with considerable severity in the spring months, but not so severely as in winter; and, since the work of the same character proposed for the city of Boston was not yet in operation, the demand for antitoxin which came, not only from the cities and towns but also from the newly equipped contagious disease hospital of Boston, for several weeks required all that the Board could supply. With the exception, however, of a few days in midsummer, it was enabled to supply all that was demanded.

The compiler recognizes, at the outset, the extreme difficulties attending the analysis of the results of the use of antitoxin, and has therefore availed himself of the recognized authorities upon the subject, and has followed their methods as closely as possible in presenting these results.

Scarcely any subject in medicine, requiring careful analysis, presents so great a multiplicity of limiting conditions and circumstances. For example, the diagnosis of the disease, the age and sex of the patient, the severity of the attack, the time elapsing before the employment of antitoxin, the previous condition of the patient, the quantity and strength of the serum employed, the existence of complications and of surgical operations performed upon the patient, — each and all of these conditions affect the result, and some of them to a very important degree.

In Dr. Welch's admirable monograph on the "Treatment of diphtheria by antitoxin" a summary is presented which gives the results of the use of antitoxin in 7,166 cases of diphtheria. This consists of the experience of 82 observers, widely separated, in different parts of the world, including France, Germany, Austria, Belgium, Switzerland, England and America. The deaths were 1,239, or 17.3 per cent. of the whole number of cases. It was estimated, from observations recorded by these same authorities, that the mean fatality in the same places and under similar conditions, before the introduction of antitoxin, was 42.1 per cent. But the foregoing figures are very largely quoted from hospital practice, wherein the fatality is invariably and for obvious reasons greater than that which occurs in general private practice.

The following figures give the fatality from diphtheria and croup in general practice in England and in Massachusetts, and, being the results of observation in over 84,000 cases, may be taken as fairly correct.

That of England for the five years (1890–94) was 24.4 per cent., being the ratio of 17,318 deaths to 71,003 reported cases; and that of Massachusetts for 1891–94 was 28.3 per cent., being the ratio of 3,768 deaths to 13,332 notified cases.

The actual fatality in Massachusetts was probably slightly less than 28.3, in consequence of the fact that the registered deaths from diphtheria may be regarded as nearly correct, while the number of reported cases must be regarded as less than the actual number, on account of failure or neglect to report in some instances, especially in small towns, where no well-organized boards of health exist.

The claim has been made that the decrease in fatality in diphtheria is not due to the use of antitoxin, but to improved modes of diagnosis, by means of bacterial cultures. On the other hand, it is also true that before the introduction of more accurate means of diagnosis it was a quite common practice with some physicians to report all cases of sore throat as diphtheria, so that these two facts must be considered together.

From all the evidence that we can obtain from recorded observations, we are inclined to believe that 25 per cent. should be considered as being about the average fatality for diphtheria in Massachusetts during the five years previous to the introduction of antitoxin. During the severe epidemic years from 1875 to 1882, it is probable that the fatality was somewhat greater.

The fatality in hospital practice may be considered as at least 50 per cent. greater than that of general practice, since mild cases do not generally reach the hospital, and many of those who are sent for hospital treatment are beyond all prospect of recovery at the time of admission.

The limited character of this report, that is to say, the defect due to the fact that a very considerable portion of the antitoxin issued is unaccounted for by any returns from those who used it, is due to several causes. First, the distribution of the material over a large extent of territory (in some instances one hundred and fifty miles or more from the base of supply); second, its use in many instances in small towns in which the physicians were unused to the work of making returns; third, about two hundred packages were

used for immunizing; fourth, a small allowance must be made for breakages of bottles and for packages remaining unused on deposit with boards of health.

The first bottles of serum, issued near the close of March, 1895, contained twenty cubic centimeters of serum each, and for several months this quantity was put into each vial; but, as the strength of the serum was increased, the size of the receptacle was diminished, first to fifteen cubic centimeters and finally to ten cubic centimeters, the latter size being at present employed exclusively, for the purpose of containing the quantity of serum most convenient for immediate use, since it is essential to its proper employment that no portion of the contents should be reserved for future use after a bottle has once been opened, unless such reserved portion be used within a few hours (twenty-four hours at the extreme limit) afterward.

The total amount of antitoxin serum issued by the Board during the year ending March 31, 1896, was 1,724 bottles, containing in all about 30,000 cubic centimeters of serum, the strength of which varied from sixty to one hundred units in each cubic centimeter.

The serum was distributed to the cities and towns as follows: —

Showing Number of Bottles of Diphtheria Antitoxin distributed to the Different Towns and Cities from March 23, 1895, to April 1, 1896.

City or Town.		Number Bottles.	City or Town.		Number Bottles.
Boston:			Worcester,		101
Boston,	45		Lynn,		83
East Boston,	4		Woburn:		
South Boston,	23		Woburn,	74	75
Jamaica Plain,	1		North Woburn,	1	
Charlestown,	1		Newton:		
Roxbury,	8	368	Newton,	10	
Dorchester,	9		West Newton,	2	71
City Hospital,	195		Newton Upper Falls,	1	
Children's Hospital,	81		City Hospital,	58	
Massachusetts General Hospital,	1		Brookline,		70
Cambridge:			Waltham,		56
Cambridge,	82		Everett,		47
Cambridgeport,	41	288	Malden,		43
City Hospital,	146		Taunton,		42
North Cambridge,	19		Stoneham,		34

Showing Number of Bottles of Diphtheria Antitoxin distributed to the Different Towns and Cities from March 23, 1895, to April 1, 1896 — Continued.

City or Town.		Number Bottles.	City or Town.		Number Bottles.
Winchester,		32	Hudson,		5
Beverly,		26	Westborough,		5
Somerville:			Bedford,		4
Somerville,	21	25	Lee,		4
West Somerville,	4		Rockland,		4
Haverhill,		22	Watertown,		4
Lowell,		19	Melrose:		
Pittsfield,		17	Melrose,	3	4
Springfield,		17	Melrose Highlands,	1	
Milford,		16	Palmer:		
Abington:			Palmer,	2	4
Abington,	12	16	Three Rivers,	2	
North Abington,	4		Hardwick,		3
Amesbury,		15	Ludlow,		3
Dalton,		15	North Attleborough,		3
Arlington,		14	Southampton,		3
Braintree:			Ware,		3
Braintree,	4	14	Warren,		3
South Braintree,	10		Concord,		2
Fitchburg,		13	Brockton:		
Clinton,		12	Brockton,	1	2
North Adams,		11	Campello,	1	
Randolph,		11	Ashburnham,		2
Weymouth:			Lenox,		2
Weymouth,	2		Holbrook,		2
North Weymouth,	3	9	Monson,		2
East Weymouth,	4		Norwood,		2
Sharon,		8	Salem,		2
Hyde Park,		7	Saugus,		2
Marlborough,		7	Boylston,		1
Quincy:			Brimfield,		1
Quincy,	5	7	Cummington,		1
West Quincy,	2		Canton,		1
Westfield,		7	Danvers,		1
Foxborough,		6	Dedham,		1
Northborough,		6	Georgetown,		1
Fall River,		5	Hanson,		1

Showing Number of Bottles of Diphtheria Antitoxin distributed to the Different Towns and Cities from March 23, 1895, to April 1, 1896 — Concluded.

City or Town.	Number Bottles.	City or Town.	Number Bottles.
Harwich,	1	Sutton,	1
Lawrence,	1	Wakefield,	1
Lexington,	1	Wellesley,	1
Milton,	1	Place not stated,	2
Medford,	1	Total,	1,724
Northampton,	1		

It was distributed to the following hospitals, in accordance with the demand from them : —

In Boston, the City Hospital for Contagious Diseases, the Children's Hospital, the Massachusetts General Hospital ; in Cambridge, to the Cambridge Hospital (contagious ward) ; in Newton, to the Newton Hospital ; in Lynn, to the Lynn Hospital for Contagious Diseases ; in Waltham, to the Waltham Hospital ; in Brookline, to the Brookline Hospital for Contagious Diseases ; in Pittsfield, to the House of Mercy ; in Westborough, to the Lyman School for Boys.

The board of health of Worcester and the House of Mercy at Pittsfield lent their efficient co-operation by acting as distributing centres for the smaller neighboring towns.

In order that the results of the use of the serum issued by the Board might be known as fully as possible, a blank form was prepared and issued with each package of antitoxin, of which the following is a copy : —

Massachusetts State Board of Health.

Blank for Recording Treatment with Diphtheria Antitoxin.

Name of attending physician,
Address,
Name of patient,
Address, Age.
Results of bacteriological examination,
Physical condition of patient previous to present illness,
Date when symptoms first appeared,

Condition at time of first injection of antitoxin (underline symptoms mentioned below which are present).

LOCAL.	*Nose:* coryza, purulent discharge, false membrane. *Pharynx:* state distribution of false membrane, *Larynx:* hoarseness, cough, dyspnœa, stenosis. *Cervical glands:* changes,
GENERAL.	General appearance: degree of prostration, etc., *Lungs:* note character and extent of involvement, *Heart:* note strength of action and any abnormalities, *Kidneys:* give analysis of urine, Other complications,

The subsequent history is to be noted on the chart on the next page.

This blank should be properly filled and returned to the office of the Board, Room 142, State House, in each and every case in which antitoxin furnished by the Board is employed.

Date. Give Hour of Observation.	Temperature.	Pulse.	Respiration.	Changes in Local Condition.	Changes in General Condition.	Amount and Source of Antitoxin injected.	NOTE. — Phenomena at Site of Inoculation. Complications. Sequelæ. Give Local and General Medication Employed.
A.M.							
P.M.							
A.M.							
P.M.							
A.M.							
P.M.							
A.M.							
P.M.							
A.M.							
P.M.							

The importance of returning these blanks properly filled with the items relative to each case does not appear to have been fully appreciated by the physicians who have used the antitoxin in different parts of the State. Our knowledge of the effect of any new therapeutic agent must be the result of observation, and it is very desirable that the observations of physicians in private practice should be fully recorded, since very much of the published results from the use of antitoxin are derived from hospital reports. Hence the Board would respectfully urge all physicians who are in the habit of obtaining the antitoxin prepared and furnished by the Board to report upon the same in as full a manner as possible.

The whole number of individual reports received by the Board from all sources for the year ending March 31, 1896, was 562. It is impossible to state the exact number treated with the antitoxin furnished by the Board during the time stated. It is probably not far from 1,000.

In order to form a just estimate of the value of this agent from the experiences recorded, it will be necessary to classify the returns,

and to separate those where a bacterial diagnosis was made by culture from those where no such examination was made. Of the former there were 289 returns and of the latter there were 273.

Cases in which a Bacterial Examination was made. — It is desirable to divide this class into two groups, — those in which the diagnosis was positive and those in which it was negative. There were 262 cases in which the diagnosis was positive, as shown by cultures taken from the throat, and of this number 36 died, or 13.7 per cent. of the whole number of positive cases.

Sex. — The number of males was 125, and the deaths of these were 18, or 14.4 per cent. The number of females was 135, and the deaths of these were 17, or 12.6 per cent. The sex of two was not stated.

Ages. — By ages the numbers and the deaths were as follows: —

Age Periods.	Cases.	Deaths.	Fatality (Per Cent.).
From 0 to 2 years,	30	9	30.0
" 2 to 5 "	71	16	22.5
" 5 to 10 "	91	9	9.9
Over 10 years,	67	2	3.0
Age unknown,	3	0	0.0
Totals,	262	36	–
Mean,	–	–	13.7

Day of Illness when Antitoxin was first administered.

Fatality,	1st day,	0.	Fatality,	5th day,	22.2
"	2d "	9.7	"	6th "	20.0
"	3d "	8.7	"	7th "	33.3
"	4th "	15.4			

In many instances the day of administration was not stated. The foregoing table relates only to those cases in which the day of illness was noted on which the antitoxin was used.

Negative Cases. — There were also 27 cases in which the bacterial examination gave either a negative or a doubtful result (23 negative and 4 doubtful), and the deaths among these were 5, or 18.5 per cent.

The fatality of positive cases treated in hospitals was as follows: cases, 85; deaths, 15, = 17.6 per cent.; in private practice, cases, 175; deaths, 21, = 11.9 per cent.

Cases in which no Bacterial Examination was made. — In the second series, in which no bacterial examination was made, the total number of cases in which antitoxin was reported as having been employed was 273, and the number of deaths recorded was 32, or 11.7 per cent.

Sex. — The number of males treated was 123, and the deaths of these were 14, or 11.4 per cent. The number of females was 143, and the deaths of these were 17, or 11.9 per cent.

Ages. — Of children under 2 years of age, 10 were treated, and the deaths of these were 5, or 50 per cent. Of children from 2 to 5 years of age there were 71 cases and 10 deaths, or 14.1 per cent. Of children from 5 to 10 years old there were 104, with 13 deaths, or 12.5 per cent. Of persons over 10 years of age there were 75, with 2 deaths, a fatality of 2.7 per cent. Of persons of unknown age there were 13, with 2 deaths.

The following record presents a brief statement of each of the fatal cases which occurred among those which had been determined by bacterial examination to be cases of diphtheria: —

Deaths.

Private Practice.

1. Male, one year (February, 1896). Marked prostration, membrane general in pharynx. Improvement for ten days, followed by paralysis of throat, hoarseness, cough and dyspnœa, considerable swelling of glands of neck, marked prostration. Ten cubic centimeters of antitoxin, time not stated.

2. Male, three years (January, 1896). Treatment begun fourth day of illness. Face flushed, membrane on right tonsil and in nares; detaching and throat clear on sixth day; hoarseness, cough and dyspnœa; glands of neck swollen on right side; heart and urine normal. Death on seventh day. Antitoxin given on fourth and fifth days, 15 cubic centimeters at each time.

3. Male, one year (November, 1895). Treatment begun fourth day of illness. Membrane slight, on both tonsils. Slight improvement and increase of membrane; cough and dyspnœa; glands of neck slightly enlarged; heart weak, rapid and irregular. Antitoxin, 10 cubic centimeters on fourth day and 10 cubic centimeters on sixth day.

4. Male, one year, eight months (December, 1895). Moderate prostration, no membrane visible; grows worse; dyspnœa; glands not enlarged; pulse rapid; moderate prostration. Intubation, second day; convulsions on sixth day and death same day. Antitoxin, 10 cubic centimeters on second day and 20 cubic centimeters third day.

5. Female, one year, four months (Dec. 2, 1895). Treatment begun fourth day of illness. General condition bad; membrane on both tonsils; purulent discharge. Throat clear on third day; hoarseness, cough, dyspnœa and stenosis; glands enlarged; pulse weak. Intubation on fifth day; death during intubation. Antitoxin, 8 cubic centimeters on fourth day.

6. Male, twenty-four years (Oct. 16, 1895). Treatment begun third day of illness. Great cyanosis and prostration; membrane on both tonsils and right portion of pharynx; hoarseness, cough and dyspnœa; pulse weak, 100–140, temperature, 100–102; considerable prostration. Antitoxin, third day, morning, 12 cubic centimeters; afternoon, 8 cubic centimeters. Death, fifth day.

7. Male, five years, six months (Oct. 7, 1895). Membrane over tonsils and arches; glands enlarged; pulse irregular and intermittent; paralysis of heart; death. Eruption on whole body, like scarlet fever. Antitoxin, 15 cubic centimeters (day not stated), 5 cubic centimeters on following day.

8. Female, four years (Sept. 21, 1895). Treatment begun second day of illness. Prostration marked; membrane on both tonsils and half arches; glands much enlarged; pulse very weak; urine albuminous; delirium and death. Antitoxin on second day, 15 cubic centimeters. Extravasated blood spots on body after injection.

9. Female, eight years (Sept. 27, 1895). Toxæmia from outset; membrane on tonsils, uvula and posterior pharynx; profuse nasal discharge; marked swelling of glands; pulse rapid and weak. Death on fourth day. Antitoxin, 30 cubic centimeters.

10. Male, nine months (Sept. 7, 1895). Treatment begun fourth day of illness. Temperature, 103–104; pulse, 160–175. Extreme septic appearance; prostration; no membrane; coryza; increasing nasal discharge; dyspnœa; glands very much enlarged on both sides. Antitoxin, 10 cubic centimeters on fourth day.

11. Male, nine months (June 25, 1895). Treatment begun fifth day of illness. Temperature, 101.5–102.1; pulse, 140–170; marked prostration; hoarseness, cough and dyspnœa; glands swollen and tender; heart weak and rapid. Antitoxin, 12 cubic centimeters on fifth day.

12. Male, nine years (Sept. 4, 1895). Treatment begun second day of illness. Temperature, 99–101; pulse, 100–120. Slight prostration; membrane on tonsils, uvula and posterior wall of pharynx; not separating; hoarseness and dyspnœa; glands enlarged; heart normal; urine normal. Antitoxin, 10 cubic centimeters on second day.

13. Male, three years. Treatment begun April 7, 1895, sixth day of illness. Temperature, 99.4–100.5; pulse, 104–135; drowsy; no membrane; coryza on sixth day, less on seventh day; glands enlarged; broncho-pneumonia. Antitoxin, 20 cubic centimeters sixth day, 20 cubic centimeters seventh day.

14. Female, two years (May 20, 1895). Treatment begun fourth day of illness. Temperature, 102–104; pulse, 160; moderate prostration; drowsy; membrane covering tonsils and uvula, separating on fifth day; glands enlarged and indurated; urine scanty and albuminous. Antitoxin, 15 cubic centimeters fourth day, 10 cubic centimeters fifth day and 5 cubic centimeters sixth day.

15. Female, three years (treatment begun May 25, 1895, seventh day of illness). Temperature, 101; pulse, 112–116; marked prostration; membrane generally over tonsils and pharynx; glands not swollen; pulse weak, but regular; urine very albuminous; specific gravity, 1032. Antitoxin, 15 cubic centimeters on seventh day.

16. Male, three and one-half years (treatment begun May 25, 1895, fourth day of illness). Temperature, 99–100; pulse, 132–152; slight prostration, increasing on fifth day; membrane over tonsils, palate and uvula, separating on fifth day; hoarseness and slight dyspnœa; glands on right side enlarged; pulse rapid; prostration and dyspnœa increasing till death. Antitoxin, 15 cubic centimeters on fourth day, A.M., 10 cubic centimeters P.M. and 10 cubic centimeters on fifth day, A.M.

17. Male, seven years (treatment begun April 25, 1895, fifth day of illness). Considerable prostration; hoarseness; cough; dyspnœa; stenosis; urine albuminous; intubation; complicated with scarlet fever and measles. Died at 9.15 P.M., fifth day. Antitoxin, 20 cubic centimeters on fifth day.

18. Female, three years (treatment begun May 1, 1895). Slight prostration; membrane on tonsils, disappearing May 18; glands enlarged; complicated with scarlet fever. Died May 18. Antitoxin 20 cubic centimeters May 1, 20 cubic centimeters May 18.

Cambridge Hospital.

19. Female, one year, six months (admitted Aug. 14, 1895, fifth day of illness). Temperature, 101.6; pulse, 136, on fifth day. Considerable toxæmia; membrane over both tonsils, separating; hoarseness; glands enlarged and hard; heat normal; general paralysis and death September 18. Antitoxin, 12 cubic centimeters on fifth day and 12 cubic centimeters on sixth day. Negative culture on August 31, followed by rash all over body, gradually disappearing.

Boston City Hospital.

20. Sex not stated, four years (admitted June 1, 1895). Treatment begun third day of illness. General condition weak; membrane on both tonsils, separating on fifth day; glands swollen; heart weak; child vomits everything. Antitoxin, 10 cubic centimeters on third day, 10 cubic centimeters on fourth day.

21. Female, three and one-half years (admitted May 1, 1895). Treatment begun fourth day of illness. Temperature, 99; pulse, 134; slight prostration; membrane on both tonsils and in pharynx; throat nearly clear on seventh day; tonsils slightly enlarged; heart rapid; urine albuminous; bronchitis. Antitoxin, 15 cubic centimeters on fourth day. Removed from another hospital without consent of physician.

22. Female, four years (admitted June 11, 1895). Treatment late. Temperature, 103; pulse, 120; general condition bad; membrane on uvula and tonsils, separating; dyspnœa; glands not swollen; heart weak. Antitoxin, 20 cubic centimeters (1–50,000). Injection delayed on account of objections of family. Death from suffocation four and one-half hours after injection.

23. Female, nine years (admitted July 12, 1895). Treatment begun second day of illness. Temperature, 101.2–103; pulse, 60–150; general condition good; some prostration; membrane on left tonsil and soft palate; glands of neck swollen; pulse regular, rapid; urine normal; thin, glairy discharge from mouth. Antitoxin, 12 cubic centimeters on second day, 12 cubic centimeters on second day, 13 cubic centimeters on third day.

24. Female, two years (admitted May 3, 1895, fifth day of illness). Temperature, 102.3; pulse, 126; membrane thick on both tonsils; hoarseness and dyspnœa; glands slightly swollen; circulation poor; prostration; complicated with sepsis. Antitoxin, 20 cubic centimeters on fifth day.

25. Male, six years (admitted May 9, 1895). Temperature, 98–101; pulse, 100–132; great prostration; membrane thick on tonsils, uvula, pharynx and soft palate, separating third day after admission to hospital; hoarseness and dyspnœa; glands enlarged; pulse weak. Antitoxin, 20 cubic centimeters May 9, A.M., 20 cubic centimeters May 9, P.M., 20 cubic centimeters May 11.

26. Female, one year, six months (admitted April 26, 1895). Temperature, 99.4–104; pulse, 110–160; considerable prostration; membrane on tonsils and uvula; purulent discharge from nose; separating April 29; glands swollen; broncho-pneumonia, complicated with sepsis. Antitoxin, 12.5 cubic centimeters April 26, 12.5 cubic centimeters April 27.

27. Female, one year, six months (admitted April 29, 1895). Temperature, 98.4–102; pulse, 120–160; slight prostration; membrane on tonsils; no change; glands swollen; urine albuminous; sepsis May 4; extreme prostration May 3. Antitoxin, 20 cubic centimeters April 29.

28. Female, six years (admitted May 15, 1895). Temperature, 98–101.8; pulse, 68–140; extreme prostration; thick membrane over both tonsils, uvula and soft palate; purulent discharge from nose; epistaxis; no improvement; hoarseness, cough and dyspnœa; glands slightly swollen; pulse weak; heart failure May 22; complicated with scarlet fever. Antitoxin, Gibier's, May 15, 25 cubic centimeters; S. B. H., May 16, 25

cubic centimeters; S. B. H., May 17, 25 cubic centimeters; S. B. H., May 18, 25 cubic centimeters.

29. Male, three years (admitted May 15, 1895, second day of illness). No prostration; membrane in small patches on tonsils; separating; throat clear on second day; stenosis; glands not swollen; heart and urine normal; scarlet fever; pneumonia in left chest on fourth day. Antitoxin, 20 cubic centimeters second day, third day and fourth day.

30. Male, three years (admitted May 26, 1895, second day of illness). Prostration; patches on tonsils; hoarseness, cough, dyspnœa and croup; glands slightly enlarged; heart weak; tracheotomy; pneumonia. Antitoxin, 20 cubic centimeters on second day, fourth day and fifth day.

31. Male, five years (admitted May 29, 1895). Extreme prostration; membrane thick on tonsils and uvula; no change; dyspnœa; glands slightly swollen; pulse very weak and irregular; heart failure; sepsis. Antitoxin, 20 cubic centimeters, May 29 and May 30.

32. Female, five years (admitted May 24, 1895). Considerable prostration; membrane one-third over tonsils and uvula; separating May 31; glands not swollen; sepsis June 9; great prostration; great pain; delirium. Antitoxin, 20 cubic centimeters, May 24, 25, 27 and 30.

33. Male, four and one-half years (admitted April 16, 1895, third day of illness). Temperature, 98 4–102; pulse, 112–160; considerable prostration; membrane on tonsils and uvula, diminishing on fifth day; glands enlarged; broncho-pneumonia. Antitoxin, 20 cubic centimeters on third day, 20 cubic centimeters on fourth day and 20 cubic centimeters on fifth day.

34. Male, four years (admitted April 13, 1895, sixth day of illness). Temperature, 100; pulse, 120; condition very septic; membrane on tonsils and uvula; urine albuminous. Antitoxin, 20 cubic centimeters on sixth day.

35. Female, two years (admitted April 22, 1895). Temperature, 98–100.4; pulse, 100–152; condition extremely septic; membrane on tonsils and uvula; epistaxis on April 24; glands enlarged; urine slightly albuminous; extreme prostration April 25. Antitoxin, 20 cubic centimeters, April 22.

Newton Hospital.

36. Female, twenty-two years (admitted March 24, 1895, fourth day of illness). Temperature, 99.8–103.8; pulse, 100–108; marked prostration; membrane over tonsils, uvula and post-pharyngeal wall, separating on fifth day; throat clear on ninth day; hoarseness and dyspnœa; glands swollen; pulse irregular. Antitoxin, 10 cubic centimeters on fourth day, 23 cubic centimeters fifth day, 15 cubic centimeters sixth day, A.M., 23 cubic centimeters P.M., 23 cubic centimeters seventh day.

An exact statement cannot be made as to the strength of the serum used in each of the foregoing cases, but it may be said in general terms that those treated before Jan. 1, 1896, were treated with the weaker serum, 1 to 50,000, and the remainder with the stronger serum, 1 to 75,000 or 1 to 100,000.

The value of antitoxin as a therapeutic agent cannot be determined by figures alone. The varied circumstances and conflicting conditions which surround and influence any case of diphtheria are so great that we are compelled to seek other sources of information than those which are purely statistical in their character.

The clinical experience of the multitude of observers, who, in hospital and in private practice, during the past two years have testified to its value, must be weighed and considered in connection with the statistical facts presented.

Dr. Mason makes the following statement relative to the use of antitoxin at the Boston City Hospital in 1895: —

If we compare this death-rate from diphtheria of 11 per cent. since the introduction of antitoxin with that of a death-rate in the hospital of 40 per cent. before the introduction of antitoxiu, there can be but one opinion regarding the efficacy of the remedy.

The change in the appearance of diphtheria wards since the introduction of the use of antitoxiu has been very marked. In making a visit one cannot help being struck with the bright and cheerful appearance of the children.*

One of the most noted German authorities (Baginsky) says: —

Naked figures are so little the expression of the endless variations of clinical observation, of all those fortunate and unfortunate accidental circumstances which pertain to the constitution and nutrition of the patient, and of the complications and difficulties which may bring danger in a mild attack, or lead to a successful issue an apparently severe attack, that to the clinical observer such figures appear of little value, in comparison with the treasure-house of his accumulated experience.

One of the most convincing proofs of the value of antitoxin is mentioned by the same writer, in what he terms an *involuntary* experiment, "where, in consequence of an interruption of the use of antitoxin at a well-known hospital, in consequence of the failure of the supply, for a period of a few weeks the mortality among the diphtheria patients immediately rose again to its former height."

* Boston Medical and Surgical Journal, Feb. 13, 1896, p. 178.

The following extracts are from the returns made to the Board by physicians using the serum: —

"This case was one that, before the days of culture tests, would have been called an undoubted case of true diphtheria, and I did not feel justified in waiting for the result of the culture to be reported to me before making use of the antitoxin."

"Child got on without any set-back whatever. I have never had a case do so well before using antitoxin."

"No local treatment. Internally, some tincture of iron, brandy and nourishing diet. Within twelve hours after injection of antitoxin child began to improve both in general and local symptoms."

"Improvement in twenty-four hours was remarkable."

"I have no doubt that antitoxin treatment has done much to help save these cases." (By physician of forty years' experience.)

"These cases, it seems to me, furnish undoubted proof of the efficacy of antitoxin. . . . The beneficial effects were almost immediate. No extension of the membrane occurred. It was being expelled on the second day, and on the fourth day the throat was clear. Improvement in the general condition was also rapid. The result is all I think could be expected or desired."

"This case was a highly satisfactory one in the marked improvement immediately following antitoxin."

"The case was a very severe one, and would probably have proved fatal had not the disease been arrested promptly by the use of antitoxin. Four adults concerned more or less in the care of the child were immunized each with 5 cubic centimeters antitoxin. All escaped the disease." (Physician of thirty years' experience.)

"In this case the disease seemed to have been arrested by the antitoxin."

"This is my first experience in the use of antitoxin. The result is exceedingly gratifying to me and to the parents. The change in the appearance of the fauces was very apparent six hours afterward. After the second injection the membrane cleared off as I have never seen it before, and the patient's symptoms disappeared with a rapidity to which I am entirely unaccustomed. I ascribe this remarkable change to the use of the serum."

"I consider that the use of antitoxin in this case was not only beneficial but absolutely the only curative agent."

"I have been in the habit of seeing such cases die. I think the favorable result may honestly be attributed to the use of antitoxin."

"Sixteen others, of all ages, living in the same house, were immunized; none of them had diphtheria."

"Child recovered. This was one of those cases that usually proves fatal in about twenty-four hours under the old treatment."

"Action of antitoxin marvellous."

"My cases have fortunately done well, and it seems to me to be due to the prompt use of the antitoxin." (A physician of thirty years' practice.)

"In this family there occurred seven cases of diphtheria. I am satisfied that without antitoxin I should have lost four of them."

"This patient began to improve after using antitoxin."

"Since last December I have treated thirty-two cases of true diphtheria; the first eight without antitoxin, of which four died; and the remaining twenty-four with antitoxin, with only one death. At least half of the last series of cases were as severe as the first eight."

"A physician of more years in experience than myself, who saw the patient the day of the injection, considered that the case was hopeless without the antitoxin."

"Antitoxin saved this child's life."

"Rapid improvement from time of injection."

The following conclusions and recommendations are selected from the work of Baginsky, already quoted, in consequence of their practical value: —

3. The antitoxin has proved, from the first, an efficient and the best means for the prevention of diphtheria.

4. The technique of injection corresponds with that of ordinary subcutaneous injections, and in like manner presupposes the strict employment of aseptic methods.

5. (*a*) The serum acts most successfully the sooner it is applied after the first appearance of illness. A combination of its use with the ordinary aseptic local treatment of diphtheria is entirely rational, and is recommended for practical use. By this combined method we have succeeded in diminishing the fatality to one-third of its former rate.

(*b*) The dose depends on the early or late period of its employment, the severity of illness and the age of the patient. It varies from 600 to 4,000 antitoxin units. An advantage is gained by using the whole dose at the outset. Nevertheless, in stubborn cases an increased dose may be given.

6. The effect of the remedy is manifest in the limitation and arrest of the local processes; also in the rapid dissolution and removal of the diseased product and in the general improvement, which generally shows itself in the lessening of febrile reaction.

7. The remedy appears most efficient in non-septic cases of diphtheria; nevertheless, cases in which mixed infectious and septic diphtheria are coincident are favorably affected by its use. A larger dose is necessary in such cases.

8. The use of the antitoxin is followed by no serious results or illness. The eruptions which often follow its use, although attended with swollen glands or affections of the joints, are wholly without danger. Kidney or heart symptoms do not result from its use.

The following list presents the names of the cities and towns from which detailed reports were received relative to the use of antitoxin, with the number from each town and the number of physicians reporting in each: —

List of Cities and Towns from which Reports have been received Relative to the Use of Antitoxin in the Treatment of Diphtheria, with the Number of Reports from Each and the Number of Physicians reporting in Each.

Places.	Number Physicians reporting.	Cases in which Cultures made.	No Cultures.	Places.	Number Physicians reporting.	Cases in which Cultures made.	No Cultures.
Boston,	32	89	26	Haverhill,	4	-	9
Dorchester,	-	7	2	Stoneham,	2	-	11
Allston,	-	3	-	Amesbury,	3	-	7
Brighton,	-	2	-	Waltham,	1	3	-
South Boston,	-	19	2	Arlington,	3	1	4
Roxbury,	-	7	-	Millbury,	3	1	3
Mattapan,	-	1	-	Westborough,	1	3	1
Jamaica Plain,	-	1	-	Lawrence,	1	1	-
Charlestown,	-	-	1	Beverly,	2	2	5
Cambridge,	23	37	12	Milford,	2	1	2
Cambridgeport,	-	-	11	Belmont,	-	2	-
North Cambridge,	-	-	5	Milton,	1	2	-
Woburn,	8	4	55	Dalton,	2	-	9
Everett,	8	21	11	Quincy (West),	1	-	2
Winchester,	5	5	17	Sharon,	1	-	5
Lynn,	14	4	21	Weymouth,	1	-	2
Lowell,	7	9	-	East Weymouth,	-	-	1
Worcester,	25	24	8	Somerville,	3	-	1
Taunton,	4	9	3	West Somerville,	-	-	1
Brookline,	4	7	1	Foxborough,	2	2	1
Malden,	4	3	6	Medford,	-	-	2
Newton,	5	-	1	Westfield,	1	-	2
Newtonville,	-	5	-	Braintree,	2	-	1
West Newton,	-	1	-	South Braintree,	-	-	2
Upper Falls,	-	3	-	Melrose Highlands,	-	-	2
Auburndale,	-	2	-	Bedford,	1	2	-

List of Cities and Towns from which Reports have been received Relative to the Use of Antitoxin, etc. — Concluded.

Places.	Number Physicians reporting.	Cases in which Cultures made.	No Cultures.	Places.	Number Physicians reporting.	Cases in which Cultures made.	No Cultures.
Bradford,	2	-	2	Canton,	1	-	1
Wellesley,	-	1	-	Ware,	1	-	1
Bolton,	1	1	1	Rockland,	1	-	1
Holden,	1	1	-	Swampscott,	1	-	1
Southbridge,	-	1	-	Westhampton,	-	-	1
Sutton,	1	1	-	Hudson,	1	-	1
Clinton,	3	-	1	Norwood,	1	-	1
Pittsfield,	1	-	1	Northborough,	1	-	1
Attleborough,	-	-	1	Monson,	1	-	1
North Attleborough,	2	-	1	North Brookfield,	1	-	1
Springfield,	1	-	1	Ludlow,	1	-	1

As soon as the discovery of the new remedy, *diphtheria antitoxin*, was made known to the world, and the methods of its preparation were also made public, several establishments both in Europe and in America undertook its manufacture, and different brands of antitoxin were offered for sale. In order, therefore, that the quality of the different preparations of so important a remedy might be determined for the benefit of local boards of health, hospitals and physicians in active practice throughout the State, the State Board of Health, acting under the provisions of the food and drug act of 1882, directed an examination of the preparations in the market to be made, and published the result in a circular, of which the following is a copy : —

State House, Boston, April 6, 1896.

Under authority of the statutes relating to food and drug inspection, the State Board of Health has examined such samples of antitoxin as are offered for sale in Massachusetts, with the following results : —

Serum No. 2, Behring. Bottle containing 10 cubic centimeters of serum, of an advertised strength of 1,000 units. The test showed that the serum was up to the standard.

Serum of Parke, Davis & Co. Bottle guaranteed to contain 10 cubic centimeters, of a total strength of 1,000 units. The test showed that the serum was up to the standard.

Serum No. 2 of Mulford & Co. The label states that the bottle contains 10 cubic centimeters, of a total strength of 1,000 units. The test confirmed the statement, and showed the serum to be up to the guaranteed strength.

Serum of the Pasteur Institute of Paris, France (Roux). The circular states that the serum is at least 1 to 50,000 in strength. As this is considered equivalent to Behring's serum No. 1, the test was carried out with this strength in view. It was, however, found to be weaker than this. A second test showed that the 10 cubic centimeters of serum contained a total of 500 antitoxic units, instead of 600 units.

Gibier's Diphtheria Antitoxin, New York. The label states that the bottle contains 25 cubic centimeters, of a total strength of 2,500 units. The test showed that the serum was far below this in strength. In a second test it was determined that the bottle contained from 625 to 750 units, instead of 2,500, as advertised. The strength of this serum is thus a trifle below one-half of that of Behring's serum No. 1.*

THE STATE BOARD OF HEALTH.

Copies of the foregoing circular were distributed generally among physicians and boards of health throughout the State.

* Ten cubic centimeters of Behring's serum No. 1 contain 600 units.

STATISTICAL SUMMARIES.

STATISTICAL SUMMARIES OF DISEASE AND MORTALITY.

In the last report of the Board, the statistical material collected by the Board was published together under the head of "Statistical Summaries of Disease and Mortality." These summaries comprise the statistics obtained from the authorities of cities and towns, and are partly voluntary and partly the result of legal requirements.

They are as follows: —

1. *The Weekly Mortality Returns.* — These consist of the reports of deaths, which are made up weekly and are sent to the office of the State Board by the registration officials of cities and towns. They are voluntary, and serve principally to show the seasonal prevalence of each of the chief infectious diseases, and the mortality of children under five years old in weekly periods. This series of statistics has been continued by the Board for at least twenty years, and has been published as a summary for thirteen years.

2. *The Reports of Certain Infectious Diseases, — Diphtheria and Croup, Scarlet Fever, Typhoid Fever and Measles.* — These are obtained from the annual reports of local boards of health for the year 1895, which are forwarded to the State Board from cities and towns. By comparing the numbers of reported cases with the reported deaths, the mean fatality of each disease in the places from which the reports are made is obtained with a reasonable degree of accuracy.

3. *Reports of Cities and Towns, made under the Provisions of Chapter 302 of the Acts of 1893.* — By this act each local board of health is required to report to the State Board every case of "disease dangerous to the public health" which is reported to the local board. A digest of these reports is presented in the following Summary (No. III.).

4. *Reports made under the provisions of Chapter 218 of the Acts of 1894.* — The full reports of deaths occurring in each city and town having over 5,000 inhabitants comprise another series of returns, which are summarized in No. IV. These reports are made under the requirements of the following statute: —

[ACTS OF 1894, CHAPTER 218, SECTION 3.]

In each city and town having a population of more than five thousand inhabitants, as determined by the last census, at least one member of said board shall be a physician, and the board shall send an annual report of the deaths in such town to the State Board of Health. The form of such reports shall be prescribed and furnished by the State Board of Health.

I.

SUMMARY OF THE WEEKLY MORTALITY RETURNS FROM CITIES AND TOWNS.

The following summary comprises the returns of deaths which are reported to the State Board of Health at the close of each week by such registration officials of cities and towns as comply with the request of the State Board of Health for this information. The data thus collected are entirely obtained from voluntary sources, and the results are compiled at the office of the board each week for publication in a bulletin which is distributed to the registering officers of the cities and towns. The facility of distributing this bulletin has been recently increased in consequence of a change in the postal laws, which admits the bulletin to the mails at a diminished rate of postage. It is also a useful medium for the publication of such information as it may become desirable to issue at more frequent intervals than is possible in the annual reports of the Board. The value of the weekly mortality returns consists very largely in the fact that they constitute a continuous history of the prevalence of the principal infectious diseases throughout the State, so far as can be learned from the mortality which they cause.

In connection with the results of the information obtained as a consequence of the enactment of chapter 302 of the Acts of 1893, these weekly mortality reports furnish to the Board an important index of the health of the people, as influenced by the prevalence of epidemic diseases at different seasons of the year.

The estimated mean population contributing to these returns during the year 1895 was about 1,495,000, or about three-fifths of the total population.

The data embraced in this summary are the following: —

Average height of barometer for each week.
Mean maximum temperature.
Mean minimum temperature.
Rainfall expressed in inches.
Humidity.
Total deaths reported for each week.
Deaths of children under five years.
Deaths from infectious diseases.
Deaths from consumption.
Deaths from acute lung diseases.
Deaths from typhoid fever.
Deaths from diarrhœal diseases.
Deaths from scarlet fever.
Deaths from measles.
Deaths from diphtheria and croup.
Deaths from puerperal fever.
Deaths from whooping-cough.
Deaths from malarial fever.
Deaths from small-pox.
Deaths from erysipelas.

The following table presents a summary of the statistics compiled from the weekly mortality returns: —

Summary.

Date.	Barometer.	Maximum Thermometer. Mean for Each Week.	Minimum Thermometer. Mean for Each Week.	Rain. Inches per month.	Humidity.	Total Deaths.	Deaths under Five Years of Age.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Diarrhœal Diseases.	Whooping-cough.	Malarial Fever.	Small-pox.	Puerperal Fever.	Erysipelas.
Jan. 5,	30.15	29	15	-	58	536	193	47	78	5	35	11	1	5	4	-	-	-	1
12,	30.17	43	29	-	88	566	152	60	86	4	39	9	1	3	4	1	-	1	-
19,	29.96	37	22	-	72	476	170	46	94	2	25	8	1	2	3	-	-	-	2
26,	29.82	38	22	3.46	65	538	188	72	98	6	28	7	4	6	4	-	-	1	1
Feb. 2,	30.09	30	18	-	70	603	169	70	110	2	32	13	-	3	4	-	-	4	3
9,	29.70	20	5	-	65	559	218	72	100	3	26	6	1	7	4	-	-	1	-
16,	29.85	36	19	-	60	733	198	80	166	2	34	11	2	10	1	-	-	2	1
23,	29.82	38	23	1.05	61	743	226	88	209	2	26	10	3	6	2	-	-	-	2
March 2,	29.85	23	40	-	66	800	193	84	217	3	20	6	-	14	4	-	-	3	5
9,	29.98	38	26	-	77	678	196	84	156	6	15	8	2	8	1	-	-	-	-
16,	30.03	38	26	-	66	632	148	66	195	5	15	6	-	3	2	-	-	-	2
23,	30.00	39	27	-	52	596	178	74	116	6	17	10	2	6	5	-	-	-	5
30,	29.89	46	31	2.66	62	620	147	68	128	3	22	9	3	7	3	-	-	1	1
April 6,	29.94	45	31	-	53	546	150	48	92	4	19	4	-	5	4	-	-	1	4
13,	30.11	54	36	-	68	623	203	76	112	8	23	13	2	5	2	-	-	1	1
20,	29.97	51	39	-	70	533	152	68	155	7	18	7	4	6	8	-	-	1	1
27,	30.07	63	44	4.54	61	583	195	63	100	5	23	9	1	6	2	-	-	1	6
May 4,	30.27	63	43	-	76	546	186	64	85	7	16	7	1	10	6	1	-	2	5
11,	30.04	81	58	-	66	552	179	56	89	3	18	5	2	10	2	-	-	-	1
18,	29.95	59	43	-	64	506	132	68	73	3	16	8	3	7	1	-	-	-	4
25,	30.14	66	49	2.52	57	550	117	53	73	7	16	11	2	6	1	-	-	-	-
June 1,	29.89	75	57	-	69	490	135	69	58	7	15	8	8	11	2	-	-	1	-
8,	30.09	70	58	-	69	497	147	87	54	8	24	4	5	14	1	1	-	1	1
15,	30.05	80	61	-	68	413	118	52	36	5	23	7	3	6	3	-	-	-	-
22,	30.15	74	61	-	74	422	113	59	28	3	19	5	3	12	2	-	-	-	-
29,	30.06	69	61	2.81	88	368	110	41	30	2	11	6	1	22	1	-	-	1	-
July 6,	30.01	74	60	-	75	401	132	43	35	6	6	6	2	31	2	-	-	-	1
13,	29.96	77	62	-	74	437	166	56	16	4	15	8	6	78	7	-	-	2	2
20,	30.01	74	60	-	78	584	290	53	35	5	15	7	1	140	1	-	-	-	2
27,	29.90	81	65	3.86	67	638	327	51	23	7	13	4	-	186	-	2	-	-	1
Aug. 3,	29.88	76	59	-	63	650	358	41	31	9	12	3	-	193	3	-	-	-	-
10,	29.92	84	66	-	64	723	392	51	18	14	18	3	-	192	2	-	-	-	-
17,	29.94	77	74	-	73	612	329	41	20	12	14	6	-	137	1	-	-	1	-
24,	29.94	78	59	-	62	615	290	50	28	11	17	6	-	132	1	1	-	1	-
31,	29.98	80	63	3.56	72	483	292	51	29	14	19	4	-	136	6	-	-	1	2

Sept. 7,	30.00	76	59	-	70	559	254	54	23	14	21	3	1	113	2	1	-	-	1
14,	30.03	73	59	-	73	576	291	54	21	11	24	6	-	127	1	-	-	1	2
21,	30.06	71	53	-	73	565	242	57	27	15	24	3	-	86	2	-	-	1	-
28,	30.06	78	61	2.45	69	567	305	46	43	23	32	9	-	125	2	-	-	1	1
Oct. 5,	30.09	63	43	-	70	572	241	61	41	13	21	1	1	85	5	1	-	-	-
12,	29.98	60	43	-	73	514	199	65	36	11	28	2	-	42	3	-	-	2	-
19,	29.86	59	43	-	76	552	177	54	52	12	30	3	-	33	2	1	-	-	-
26,	30.03	54	38	5.03	64	529	176	57	62	11	34	5	-	28	2	1	-	-	1
Nov. 2,	30.35	54	38	-	67	509	159	65	65	14	36	2	1	13	-	1	-	1	1
9,	30.17	63	44	-	86	560	164	66	76	12	50	1	-	14	3	-	-	-	-
16,	30.19	40	37	-	83	501	129	60	65	11	42	3	-	8	1	-	-	-	1
23,	29.96	51	36	-	73	505	151	54	73	5	36	3	-	11	2	-	-	-	1
30,	30.22	51	36	5.98	74	517	136	49	60	9	39	2	-	12	-	-	-	-	-
Dec. 7,	29.96	39	25	-	68	508	153	56	61	7	45	6	-	11	1	-	-	-	1
14,	30.11	27	15	-	72	506	154	49	71	9	48	2	-	8	1	-	-	2	-
21,	30.41	48	33	-	72	592	169	64	94	13	41	4	1	8	1	-	-	-	2
28,	30.04	49	39	3.35	81	494	125	56	94	15	34	2	3	4	1	-	-	-	1
Totals,	-	-	-	41.27	-	28,978	10,114	3,119	3,937	405	1,289	312	71	2,153	128	11	-	35	66
Weekly averages,	-	-	-	-	-	557	194	60	76	8	25	6	1.37	41.4	2.46	.2	-	.7	1.27
Rate per 1,000 deaths,	-	-	-	-	-	-	349.	111.9	135.9	14.0	44.5	10.8	2.45	74.3	4.42	.38	-	1.2	2.3
Rate per 1,000 population,	-	-	-	-	-	19.4	6.77	2.09	2.63	.27	.86	.21	.047	1.44	.086	.007	-	.023	.044

Average reporting population, ... 1,495,000

Total Deaths.

The whole number of deaths reported for the year 1895 from the cities and towns contributing to these reports was 28,978, and the average number per week was 557. The greatest number of deaths reported in a single week was 800, in the week ending March 2, and the least number was 368, in the week ending June 29. The weekly average number of deaths reported for each month was : —

January,	529	July,	515
February,	658	August,	617
March,	665	September,	567
April,	571	October,	542
May,	538	November,	518
June,	438	December,	525

The months in which the greatest mortality per week was reported were February, March and August, and those in which there was the least reported mortality were June, July and November.

The percentages of mortality in each of the four quarters of the year were as follows : —

	Deaths at all Ages.		Deaths under Five Years.	
	Numbers.	Percentages.	Numbers.	Percentages.
First quarter,	8,080	27.88	2,376	23.49
Second quarter,	6,629	22.88	1,937	19.15
Third quarter,	7,410	25.57	3,668	36.27
Fourth quarter,	6,859	23.67	2,133	21.09
	28,978	100.00	10,114	100.00

The death rate of reporting cities and towns was 19.4 per 1,000, the reporting population being 1,495,000.

Deaths under Five Years.

The reported number of deaths of children under five years of age was 10,114, and the average weekly number was 194. The greatest number reported in one week was 392, in the week ending August

10, and the least number was 110, in the week ending June 29. The ratio of the deaths of this class to the total mortality was 34.9 per cent., which was slightly less than that of the preceding year (36.1 per cent.). The average weekly number of deaths of children under five years of age by months was as follows: —

January,	176	July,	229
February,	203	August,	332
March,	172	September,	273
April,	175	October,	198
May,	153	November,	148
June,	125	December,	150

The months having the greatest number of deaths of children under five years of age were July, August and September, and those having the least number were June, November and December.

The relation of the death rate of children under five years of age to the death rate at all ages is fully illustrated in the diagram upon page 721 of the twenty-third annual report (1891), where the mean death rate per week for a series of nine years is given. The irregularities in the death rate at all ages in different seasons of the year is shown to be very largely produced by the marked changes in the death rate of children.

Consumption.

The number of reported deaths from consumption was 3,119, and the weekly average was 60. The greatest number of deaths reported from this cause in a single week was 88, in the week ending February 23, and the least number was 41, in the weeks ending June 29, August 3 and August 17.

The average weekly number of reported deaths from this cause in each month was as follows: —

January,	56	July,	51
February,	77	August,	47
March,	75	September,	53
April,	64	October,	59
May,	60	November,	59
June,	62	December,	56

The months having the greatest number of deaths from this cause were February and March, and those having the least were July

and September. The following table presents the variations from the weekly average number of deaths from this cause for the past five years: —

	1891.	1892.	1893.	1894.	1895.		1891.	1892.	1893.	1894.	1895.
January, .	+4	+13	+8	+10	−4	July, . .	−4	−3	−7	0	−9
February, .	−4	−8	−3	+7	+17	August, .	−3	−4	−1	−4	−13
March, .	−5	−1	+9	+9	+15	September,	−3	−11	−1	−3	−7
April, . .	+4	+7	+13	−1	+4	October, .	+3	−5	−10	−6	−1
May, . .	+6	0	+1	−7	0	November, .	−4	−4	+2	−7	−1
June, . .	−2	−5	−9	−1	+2	December, .	+5	−1	−6	+2	−4

The ratio of reported deaths from consumption to the mortality reported from all causes was 107.7 per 1,000, while that of previous years was as follows: —

1888, ...	134.2	1892, ...	111.3
1889, ...	125.0	1893, ...	106.5
1890, ...	130.0	1894, ...	111.8
1891, ...	116.5	1895, ...	107.7

The ratio to the reported living population in 1895 was 2.09 per 1,000.

Acute Lung Diseases.

The number of reported deaths from acute lung diseases (bronchitis, pneumonia, pleurisy and asthma) during the year was 3,937, and the weekly average was 76. The greatest number of deaths reported from this group of causes in a single week was 217, in the week ending March 2; and the least number was 16, in the week ending July 13. The average weekly number of reported deaths from these causes for each month was as follows: —

January, ...	89	July, ...	27
February, ...	146	August, ...	25
March, ...	162	September, ...	28
April, ...	115	October, ...	48
May, ...	80	November, ...	68
June, ...	41	December, ...	80

The months having the greatest number of reported deaths from these causes were February and March, and those having the least number were July and September. The ratio of reported deaths

from acute lung diseases to the reported mortality from all causes was 135.9 per 1,000. The estimated death rate per 1,000 of the reporting population from these causes was 2.63, as compared with 2.42 for the previous year.

Typhoid Fever.

The total number of reported deaths from this cause was 405, and the weekly average was 8. The greatest number reported in any single week from this cause was 23, in the week ending September 28; and the least number was 2, in the weeks ending January 19, February 2, 16, 23 and June 29. The average weekly number of deaths reported from this cause for each month was as follows : —

January,	4	July,	5
February,	2	August,	12
March,	5	September,	16
April,	6	October,	12
May,	5	November,	10
June,	5	December,	11

The months having the greatest number of reported deaths from this cause were August, September and November, and those having the least were January, February and May. The ratio of reported deaths from typhoid fever to the reported mortality from all causes was 14.0 per 1,000, and the ratio to the reporting population was .27 per 1,000, as compared with .28 in the previous year.

Diphtheria and Croup.

The total number of reported deaths from diphtheria and croup in 1895 was 1,289, and the average number in each week was 25. The greatest number reported in a single week from these combined causes was 50, in the week ending November 9; and the least number was 6, in the week ending July 6. The average weekly number of reported deaths from these causes for each month was as follows : —

January,	32	July,	12
February,	29	August,	16
March,	18	September,	25
April,	21	October,	28
May,	17	November,	41
June,	18	December,	42

The months having the greatest number of reported deaths per week from these causes were January, November and December,

and those having the least number were May, July and August. The ratio of deaths from diphtheria and croup to the reported mortality from all causes was 44.48 per 1,000, and the death rate of the reporting population was 86 per 1,000, that of the previous year being 95.

Scarlet Fever.

The reported deaths from scarlet fever in 1895 were 312, and the average weekly number was 6. The greatest number of reported deaths from this cause in a single week was 13, in the weeks ending February 2 and April 13, and the least number reported in a single week was 1, in the weeks ending October 5 and November 9. The average weekly number reported in each month was as follows: —

January,	9	July,	6
February,	10	August,	4
March,	8	September,	5
April,	8	October,	3
May,	8	November,	2
June,	6	December,	3

The months having the greatest number of deaths from this cause were February and March, and those having the least number were October and November. The ratio of deaths from this cause to the reported deaths from all causes was 10.80 per 1,000, and the death rate of the reporting population from this cause was .21 per 1,000, that of the previous year being .32.

Measles.

The total number of reported deaths from measles in 1895 was 71. The greatest number in a single week was 8. There were twenty-two weeks in which no deaths from measles were reported. The average weekly number reported in each month was as follows: —

January,	2	July,	2
February,	1	August,	0
March,	1	September,	0
April,	2	October,	0
May,	2	November,	0
June,	4	December,	1

The ratio of deaths to the reporting mortality from all causes was 2.45 per 1,000, and the death rate from this cause was .047 per 1,000 of the reported population, as compared with .03 in 1894.

Diarrhœal Diseases.

The diseases in this group are diarrhœa, dysentery, cholera morbus and cholera infantum. From these causes combined the number of deaths reported in 1895 was 2,153, and the weekly average number was 41. The greatest number reported in a single week was 193, in the week ending August 8, and the least number was 2, in the week ending January 19. The average weekly number of reported deaths from these causes in each month was as follows: —

January,	4	July,	109
February,	7	August,	158
March,	8	September,	113
April,	5	October,	47
May,	8	November,	12
June,	13	December,	8

The months having the greatest number of reported deaths from these causes in 1895 were July, August and September, and those having the least were January, February and April. The deaths from these causes in the third quarter of the year constituted 77.7 per cent. of the number of deaths from the same causes for the entire year. The ratio of reported deaths to the reported mortality from all causes was 74.29 per 1,000, and the death rate of the reporting population from these causes was 1.44, as compared with 1.62 in 1894.

Whooping-cough, Malarial Fever, Erysipelas and Puerperal Fevers.

The essential statistics relating to these four diseases are embraced in the following table: —

	Total Deaths Reported.	Weekly Averages.	Ratio per 1,000 of Reported Deaths from All Causes.	Ratio per 1,000 of Reporting Population.
Whooping-cough,	128	2.5	4.42	.086
Erysipelas,	66	1.3	2.30	.044
Puerperal fever,	35	.7	.12	.023
Malarial fever,	11	.2	.38	.007

II.

FATALITY (*RATIO OF DEATHS TO CASES*) FROM CERTAIN INFECTIOUS DISEASES IN 1895.

The statistics presented in the following table are compiled from the published reports of local boards of health for the year 1895 which have been forwarded to the office of the State Board of Health. They are the figures representing the numbers of cases reported to local boards of health under the provisions of section 79 of chapter 80, Public Statutes.

The numbers of deaths are also obtained from the same reports, and the comparison of these two series of figures presents a fairly accurate method of arriving at the fatality from these diseases in the places from which they are reported. The figures representing the numbers of cases are probably less than the actual numbers, since some cases must necessarily escape registration through neglect to report or in consequence of faulty diagnosis.

Cases of Infectious Diseases and Deaths reported to Local Boards of Health, 1895.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Amesbury,	24	9	65	2	9	1	225	4
Andover,	11	-	16	-	3	-	-	-
Attleborough,	6	2	12	-	7	3	3	-
Ayer,	3	-	65	-	12	-	-	-
Belmont,	10	1	8	-	1	-	-	-
Blackstone,	15	3	4	-	6	1	3	-
Boston,	4,059	654	1,612	114	1,026	163	2,733	19
Brockton,	37	13	210	4	25	8	5	-
Brookline,	97	15	24	1	9	3	21	-
Cambridge,	573	106	293	17	107	12	249	3
Canton,	3	-	13	1	3	-	-	-
Chelsea,	173	31	151	10	7	3	28	-
Chicopee,	12	5	65	5	8	4	-	1
Clinton,	4	3	19	-	9	6	185	4

Cases of Infectious Diseases, etc. — Continued.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Concord,	8	-	12	1	1	-	4	-
Cottage City,	-	-	2	-	-	-	-	-
Danvers,	2	2	37	1	2	1	45	-
Dedham,	56	7	31	-	1	-	10	-
East Bridgewater,	-	-	24	1	-	-	-	-
Easthampton,	-	-	45	-	2	1	53	-
Everett,	55	13	60	8	31	5	45	-
Fall River,	88	66	272	29	122	30	-	-
Fitchburg,	27	8	34	1	29	8	-	-
Framingham,	5	2	6	-	6	2	34	1
Franklin,	39	5	2	-	4	1	72	-
Gardner,	-	-	16	2	16	3	-	-
Gloucester,	171	25	214	6	23	4	-	-
Greenfield,	4	-	6	1	12	3	2	-
Hardwick,	16	9	-	-	-	-	-	-
Haverhill,	24	6	98	6	36	8	232	5
Holbrook,	24	1	-	-	-	-	-	-
Holyoke,	54	20	28	-	39	12	47	8
Hudson,	26	5	5	-	3	-	-	-
Hull,	6	2	-	-	-	-	5	-
Hyde Park,	23	7	35	2	16	1	99	-
Ipswich,	9	3	11	-	10	1	69	-
Lee,	13	2	5	-	-	-	-	-
Leominster,	4	-	13	-	11	-	-	-
Lexington,	1	-	7	-	3	2	3	-
Lincoln,	5	2	6	-	1	1	-	-
Lowell,	120	53	160	4	172	33	53	1
Lynn,	244	42	415	26	104	13	-	-
Marlborough,	10	2	10	1	3	-	229	1
Maynard,	2	-	8	-	-	-	-	-
Medford,	74	9	81	1	29	3	14	-
Melrose,	41	6	33	-	18	4	11	-
Middleborough,	8	2	36	1	4	2	-	-
Millbury,	6	2	15	-	2	-	2	-
Nantucket,	1	-	-	-	-	-	-	-
Natick,	3	2	-	-	-	-	-	-

Cases of Infectious Diseases, etc. — Concluded.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
New Bedford,	121	30	101	5	79	9	19	1
Newburyport,	8	1	81	2	19	8	-	-
Newton,	158	21	92	1	31	3	321	1
North Adams,	33	15	12	1	86	-	16	-
Northampton,	6	3	27	1	36	4	9	-
North Andover,	2	2	21	-	-	-	8	-
North Attleborough,	6	1	16	-	5	1	-	-
North Brookfield,	24	6	1	-	-	-	-	-
Norwood,	4	-	14	-	-	5	-	-
Palmer,	18	10	79	24	3	2	1	-
Pittsfield,	11	8	22	1	14	3	6	-
Plymouth,	10	-	57	2	17	-	-	-
Quincy,	105	17	58	4	19	5	33	-
Reading,	6	1	3	-	34	3	1	-
Revere,	28	4	3	-	4	1	-	-
Salem,	44	4	303	9	38	3	-	-
Saugus,	16	2	42	5	5	1	2	-
Somerville,	246	43	217	17	61	10	-	-
Springfield,	30	23	121	8	39	9	73	25
Swampscott,	14	2	4	-	1	-	3	-
Taunton,	155	26	26	-	5	2	-	-
Tewksbury,	-	-	39	1	3	-	-	-
Wakefield,	7	4	14	-	8	1	12	-
Waltham,	115	3	32	3	31	6	-	-
Ware,	14	8	9	-	1	1	-	-
Watertown,	25	3	7	1	4	-	5	-
Wellesley,	5	1	4	-	-	-	8	-
Westfield,	60	12	46	4	18	6	-	-
Westford,	4	1	13	-	-	-	1	-
Weston,	6	-	-	-	8	-	1	-
Whitman,	1	2	29	1	2	-	4	-
Williamstown,	10	1	7	-	11	3	-	-
Woburn,	114	15	134	17	12	5	-	-
Worcester,	254	70	132	5	139	25	29	1
Totals,	7,856	1,484	6,050	357	2,665	458	5,033	75
Fatality, per cent.,	18.9		5.9		17.2		1.5	

Andover: small-pox, 1 case; not fatal.

The cities and towns embraced in the foregoing table are 84 in number, or 8 more than those presented in the previous year, and 14 more than those which reported for 1893. They comprise at least three-fourths of the population of the State.

The list contains the names of cities and towns containing about 175,000 more inhabitants than those which were reported last year, while one important city of about 50,000 population is omitted.

Bearing these changes in mind, the reported cases from diphtheria and croup were much in excess of those of any of the previous years embraced in the report, but the fatality (18.9) was much less. Comment upon these figures will be found elsewhere.

The reported cases of scarlet fever were considerably less than those reported in 1894, and the fatality (5.9 per cent.) was less.

The reported cases of typhoid fever were less than those of 1894, and the fatality (17.2) was but slightly greater.

The reported cases of measles were two and one-half times as many as those reported in 1894, and the fatality (1.5) was less.

The figures for 1895 are as follows: —

Reported cases of diphtheria and croup,	7,856
Registered deaths from diphtheria and croup in the same cities and towns,	1,484
Fatality (per cent.),	18.9
Reported cases of scarlet fever,	6,050
Registered deaths from scarlet fever in the same cities and towns,	357
Fatality (per cent.),	5.9
Reported cases of typhoid fever,	2,665
Registered deaths from typhoid fever in the same cities and towns,	458
Fatality (per cent.),	17.2
Reported cases of measles,	5,033
Registered deaths from measles in the same cities and towns,	75
Fatality (per cent.),	1.5

The following table presents the summary of these statistics for the five years 1891–1895: —

Reported Cases of Infectious Diseases in Massachusetts.

Diphtheria and Croup.

	1891.	1892.	1893.	1894.	1895.	TOTAL.
Reported cases,	2,444	3,033	2,919	4,936	7,856	21,188
Deaths,	575	891	926	1,376	1,484	5,252
Fatality (per cent.),	23.5	29.2	31.7	27.9	18.9	24.8

Reported Cases of Infectious Diseases in Massachusetts — Concluded.

Scarlet Fever.

	1891.	1892.	1893.	1894.	1895.	Total.
Reported cases,	4,517	6,112	7,420	7,416	6,050	31,515
Deaths,	151	281	624	504	357	1,917
Fatality (per cent.),	3.3	4.6	8.8	6.8	5.9	6.1

Typhoid Fever.

	1891.	1892.	1893.	1894.	1895.	Total.
Reported cases,	2,414	1,892	2,457	2,814	2,665	12,242
Deaths,	460	435	492	488	458	2,333
Fatality (per cent.),	19.0	23.0	20.0	17.0	17.2	19.1

Measles.

	1891.	1892.	1893.	1894.	1895.	Total.
Reported cases,	5,861	783	6,290	2,051	5,033	20,018
Deaths,	84	31	98	37	75	325
Fatality (per cent.),	1.4	4.0	1.6	1.8	1.5	1.6

Considerable interest has been manifested recently in the mortality of cases reported as croup, but the impossibility of obtaining reliable statistics under the present system of reporting is apparent, since all reported cases of diphtheria and croup are embraced under one title in the published reports.

In England reported cases of croup have been placed in a separate list since 1892, as shown in the following table, which presents the fatality of diphtheria and croup separately. From this table it appears that the fatality from diphtheria for the three years 1892-94 was 23.3 per cent. of the reported cases, and that of croup was 40.7 per cent. The report also presents the following comment in support of the view that the fatality for croup is still greater than these figures would appear to show: —

The figures in the column of deaths from "membranous croup" do not include all the deaths which occurred from membranous croup, for, although that disease is considered to be related to diphtheria, the Registrar-

General's returns do not separate the deaths from those due to spasmodic croup, which is not a notifiable disease. It is believed, however, that when cases of membranous croup prove fatal they are often registered as from diphtheria.

England.

[Local Government Board figures.]

	Diphtheria.		Croup.		Total.		Per Cent.
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1890,	-	-	-	-	2,953	753	25.5
1891,	-	-	-	-	11,919	2,829	23.7
1892,	13,977	3,177	1,169	401	15,146	3,578	23.6
1893,	20,712	4,751	1,436	685	22,148	5,436	24.5
1894,	17,581	4,236	1,256	486	18,837	4,722	25.1
Total,	52,270	12,164	3,861	1,572	71,003	17,318	-
Mean fatality, per cent.,	23.3		40.7		-		24.4

The following figures present the fatality from diphtheria, scarlet fever and typhoid fever in England, as reported by the Local Government Board of England for the years 1890–94 : —

	1890.	1891.	1892.	1893.	1894.
Diphtheria,	25.5	23.7	23.6	24.5	25.1
Scarlet fever,	8.0	5.8	4.4	4.2	4.8
Typhoid fever,	19.9	20.8	17.8	17.0	17.5

III.

The following summary embraces the returns of diseases "dangerous to public health" made to the State Board of Health under the provisions of chapter 302 of the Acts of 1893. Since the act in question did not specify the diseases intended to be reported to the Board (except small-pox), the Board issued a circular, in which it expressed its opinion as to the particular diseases which should be reported under the provisions of this act. They were the following: *small-pox, scarlet fever, measles, typhoid fever, diphtheria, membranous croup, cholera, yellow fever, typhus fever, cerebro-spinal meningitis, hydrophobia, malignant pustule, leprosy and trichinosis.*

The report of 1893 embraced the returns of the fractional year only which immediately followed the enactment of the statute, while those of 1894 were for a full year.

The whole number of cases of infectious diseases reported in 1895 was 21,307, which were divided as follows: —

Reported cases of small-pox,	1
Reported cases of diphtheria and croup,	7,806
Reported cases of scarlet fever,	6,194
Reported cases of typhoid fever,	2,438
Reported cases of measles,	4,868
Total,	21,307

The summary for the years 1893, 1894 and 1895 is as follows: —

	Reported Cases of				
	Small-pox.	Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.
1893,	35	1,109	2,914	1,525	1,503
1894,	181	4,178	6,731	2,372	2,133
1895,	1	7,806	6,194	2,438	4,868
Totals,	217	13,093	15,839	6,335	8,504

Seasonal Distribution. — By months these diseases were reported as follows in 1895: —

Cases of Infectious Diseases reported to the State Board of Health by Months in 1895.

	Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.		Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.
January,	631	787	133	343	August,	497	346	384	107
February,	559	651	59	304	September,	566	400	415	44
March,	517	754	65	685	October,	756	497	466	56
April,	341	461	65	878	November,	1,380	573	339	184
May,	389	447	99	878	December,	1,120	411	193	281
June,	614	507	101	959	Totals,	7,806	6,194	2,438	4,868
July,	436	360	119	149					

In order that the foregoing figures may be interpreted with greater facility, the following table is appended: —

Intensity of Prevalence.

	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	A	B	A	B	A	B	A	B
January,	20.4	9.5	25.4	14.9	4.3	6.4	11.1	8.3
February,	20.0	9.3	23.2	13.6	2.1	3.1	10.9	8.1
March,	16.7	7.8	24.3	14.3	2.1	3.1	22.1	16.5
April,	11.4	5.3	15.4	9.0	2.2	3.3	29.2	21.8
May,	12.5	5.8	14.4	8.5	3.2	4.8	28.3	21.1
June,	20.5	9.6	16.9	9.9	3.4	5.1	32.0	23.9
July,	14.1	6.6	11.6	6.8	3.8	5.7	4.8	3.6
August,	16.0	7.5	11.2	6.6	12.4	18.5	3.4	2.6
September,	18.9	8.8	13.3	7.8	13.8	20.6	1.5	1.1
October,	24.4	11.4	16.0	9.4	15.0	22.4	1.8	1.3
November,	46.0	21.5	19.1	11.2	11.3	16.9	6.1	4.6
December,	36.1	16.9	13.3	7.8	6.2	9.2	9.1	6.8
Mean,	21.4	10.0	17.0	10.0	6.7	10.0	13.4	10.0

The figures in the foregoing table are introduced for the purpose, not of comparing the prevalence of one disease with another, but for the purpose of presenting the reports of each month upon a uni-

form basis of comparison, month by month, so that the relative intensity of each disease is shown for each month. The method also has the advantage of eliminating the apparent errors of computation arising from the unequal length of the months.

The figures may be read as follows: for example, the mean daily number of reported cases of diphtheria and croup in January was 20.4; of scarlet fever, 25.4; of typhoid fever, 4.3; and of measles, 11.1 (see columns marked A); and the mean daily number of the same diseases for the whole year 1895 was, respectively, 21.4—, 17.0—, 6.7 and 13.4. Assuming a standard of 10 as the daily mean of each disease for the year, the ratios for January were as follows: diphtheria and croup, 9.5; scarlet fever, 14.9; typhoid fever, 6.4; and measles, 8.3. (See columns marked B.) That is to say, for each 10 reported cases of diphtheria and croup occurring throughout the year, as a daily mean, there were 9.5 daily in January, 9.3 in February, etc.

The following table presents the numbers of cases of each disease reported from each city and town in 1895. The whole number of reporting cities and towns is less than that of the previous year; but, while the number of small towns reporting is less, the number of towns having over 5,000 population is greater.

Where the name of a city or town occurs both in Section II. and in Section III. of this summary, the difference in numbers may be taken as the deficiency in returns made by the local board to the State Board of Health.

Cases of Infectious Diseases reported to the State Board of Health from One Hundred and Fifty-five Cities and Towns during 1895

	Diphtheria.	Scarlet Fever.	Typhoid Fever.	Measles.		Diphtheria.	Scarlet Fever.	Typhoid Fever.	Measles.
Acushnet,	-	4	-	-	Attleborough,	4	13	3	2
Adams,	2	6	-	2	Auburn,	-	1	-	-
Agawam,	-	2	-	-	Ayer,	3	36	6	-
Amesbury,	23	68	16	162	Barnstable,	3	6	-	1
Amherst,	-	5	3	-	Bedford,	2	10	-	2
Arlington,	22	18	3	-	Belchertown,	1	2	-	2
Ashburnham,	1	-	-	-	BEVERLY,	60	40	17	4
Ashland,	2	1	-	1	Billerica,	-	3	-	-
Athol,	1	1	-	-	Bolton,	5	-	2	1

Cases of Infectious Diseases, etc. — Continued.

	Diphtheria.	Scarlet Fever.	Typhoid Fever.	Measles.		Diphtheria.	Scarlet Fever.	Typhoid Fever.	Measles.
BOSTON,	4,150	1,699	994	2,657	Hampden,	-	1	-	-
Bradford,	4	8	7	19	Hanson,	-	4	-	-
Braintree,	1	-	-	-	Hardwick,	22	1	-	-
Bridgewater,	-	5	-	-	Harvard,	1	15	2	-
Brimfield,	1	10	16	19	HAVERHILL,	28	99	39	219
BROCKTON,	32	153	9	2	Hingham,	1	9	-	-
Brookline,	84	32	-	-	Hinsdale,	-	3	1	9
CAMBRIDGE,	623	289	116	249	Holliston,	4	25	-	25*
Canton,	3	1	-	-	Hudson,	1	-	-	-
Carlisle,	-	1	-	-	Hull,	2	-	-	-
Carver,	9	-	-	-	Ipswich,	14	42	7	77
Chelmsford,	-	17	2	-	Kingston,	-	7	-	1
CHELSEA,	150	128	6	23	Lancaster,	-	-	4	46
Clinton,	1	3	-	-	LAWRENCE,	38	109	62	151
Concord,	8	18	8	1	Leicester,	9	4	-	-
Conway,	-	6	1	179	Lenox,	7	1	4	-
Danvers,	2	33	3	51	Leominster,	-	12	2	2
Dedham,	46	54	1	11	Leyden,	4	-	-	-
Dighton,	11	2	-	-	Lexington,	1	4	-	3
Dover,	-	3	-	-	Lincoln,	6	4	-	1
Dudley,	1	7	-	-	Lunenburg,	2	8	-	-
Duxbury,	1	2	-	-	LYNN,	222	382	104	158
East Bridgewater,	-	18	-	-	MALDEN,	49	40	29	26
Easthampton,	-	23	2	32	MARLBOROUGH,	5	2	-	109
East Longmeadow,	-	13	-	-	Manchester,	2	5	1	-
Erving,	1	5	-	-	Marshfield,	1	3	-	-
EVERETT,	44	49	28	45	Maynard,	-	1	-	-
Fairhaven,	-	5	-	-	MEDFORD,	40	76	26	18
FALL RIVER,	54	166	84	-	Melrose,	3	9	5	8
FITCHBURG,	27	44	35	15	Middleborough,	9	37	4	-
Foxborough,	48	21	1	-	Milford,	21	22	3	-
Franklin,	36	-	4	70	Millbury,	4	11	2	2
GLOUCESTER,	156	155	25	-	Milton,	13	5	13	7
Grafton,	-	16	1	2	Montague,	3	2	8	-
Granville,	1	1	-	-	Nantucket,	2	-	-	-
Groveland,	1	4	-	-	NEW BEDFORD,	139	94	78	18

Cases of Infectious Diseases, etc. — Concluded.

	Diphtheria.	Scarlet Fever.	Typhoid Fever.	Measles.		Diphtheria.	Scarlet Fever	Typhoid Fever	Measles.
NEWBURYPORT,	9	59	27	-	Somerset,	-	2	-	-
NEWTON,	131	91	18	259	SOMERVILLE,	228	230	38	-
NORTH ADAMS,	24	12	38	2	Southampton,	1	1	-	-
NORTHAMPTON,	5	27	48	10	SPRINGFIELD,	47	111	41	53
North Andover,	-	19	-	8	Sterling,	-	-	1	-
No. Attleborough,	7	18	-	-	Stow,	1	-	1	-
Northborough,	8	-	-	-	Sutton,	-	3	-	-
Northbridge,	1	25	-	-	Swampscott,	7	6	1	1
North Brookfield,	-	2	2	-	TAUNTON,	136	37	3	-
Norton,	-	5	-	-	Templeton,	-	1	-	-
Orange,	1	1	16	3	Tolland,	-	-	1	-
Oxford,	-	3	1	20	Upton,	-	-	1	-
Palmer,	6	68	7	-	WALTHAM,	177	68	25	-
Paxton,	-	1	-	-	Ware,	7	9	1	-
Peabody,	10	136	34	-	Warren,	1	14	3	1
Pepperell,	1	8	1	1	Watertown,	22	7	4	1
PITTSFIELD,	2	8	1	4	Webster,	5	4	10	-
Plymouth,	9	51	20	3	Wenham,	1	-	-	-
Princeton,	15	1	-	3	West Boylston,	2	35	1	-
QUINCY,	109	59	21	30	Westfield,	50	45	13	-
Randolph,	7	13	-	1	Westford,	1	18	-	1
Raynham,	6	-	-	-	Westminster,	-	8	1	-
Reading,	7	4	34	3	Weston,	6	-	7	1
Revere,	26	20	2	-	Weymouth,	13	42	2	-
Rockland,	-	42	-	-	Whitman,	1	40	-	2
Rockport,	5	2	33	-	Williamstown,	4	6	9	-
Rowley,	1	25	6	2	Winchendon,	14	2	4	-
SALEM,	45	267	34	-	Winchester,	-	2	1	1
Sandisfield,	-	-	9	-	Winthrop,	17	3	2	-
Scituate,	2	2	-	-	WOBURN,	79	113	4	-
Saugus,	14	18	6	1	WORCESTER,	250	146	123	23
Sharon,	-	1	-	-	Wrentham,	4	1	-	-
Sherborn,	4	7	-	2	Totals,	7,806	6,194	2,438	4,868

One case of small-pox in Andover.

The following list comprises the cities and towns which failed to report (under the provisions of the statute) to the State Board of

Health. It is but just to state that in many of the towns named in group IV. and in some of those in group III. it is quite probable that no cases of infectious disease occurred.

List of Towns from which no Reports were received.

I. Cities.

Chicopee, Holyoke.

II. Towns having a Population of More than 5,000 in Each.

Andover,	Marblehead,	Stoughton,
Blackstone,	Methuen,	Wakefield,
Gardner,	Southbridge,	Westborough,
Greenfield,	Spencer,	West Springfield.—14.
Hyde Park,	Stoneham,	

III. Towns having a Population of Over 1,000 but Less than 5,000 in Each.

Abington,	Groton,	Rochester,
Acton,	Hadley,	Salisbury,
Ashfield,	Hamilton,	Sandwich,
Avon,	Hanover,	Seekonk,
Barre,	Harwich,	Sheffield,
Bellingham,	Hatfield,	Shelburne,
Belmont,	Holbrook,	Shirley,
Brookfield,	Holden,	Shrewsbury,
Buckland,	Hopedale,	Southborough,
Charlemont,	Hopkinton,	South Hadley,
Charlton,	Hubbardston,	Stockbridge,
Chatham,	Huntington,	Sturbridge,
Cheshire,	Lee,	Sudbury,
Chester,	Lexington,	Swansea,
Clarksburg,	Littleton,	Tewksbury,
Cohasset,	Ludlow,	Tisbury,
Colrain,	Mansfield,	Topsfield,
Cottage City,	Mattapoisett,	Townsend,
Dalton,	Medfield,	Uxbridge,
Dartmouth,	Medway,	Walpole,
Deerfield,	Merrimac,	Wareham,
Dennis,	Millis,	Wayland,
Douglas,	Monson,	Wellesley,
Dracut,	Needham,	West Bridgewater,
Easthampton,	Newbury,	West Brookfield,
Easton,	New Marlborough,	West Newbury,
Edgartown,	Northfield,	Westport,
Essex,	Norwell,	West Stockbridge,
Falmouth,	Norwood,	Wilbraham,
Freetown,	Orleans,	Williamsburg,
Georgetown,	Pembroke,	Wilmington,
Gill,	Provincetown,	Yarmouth.—98.
Great Barrington,	Rehoboth,	

LIST OF TOWNS FROM WHICH NO REPORTS WERE RECEIVED — *Concluded.*

IV. Towns having Less than 1,000 Inhabitants.

Alford, Ashby, Becket, Berkley, Berlin, Bernardston, Blandford, Boxborough, Boxford, Boylston, Brewster, Burlington, Chesterfield, Chilmark, Cummington, Dana, Dover, Dunstable, Eastham, Egremont, Enfield, Florida, Gay Head, Gosnold, Goshen, Granby, Greenwich, Halifax, Hancock, Hawley, Heath, Holland, Lakeville, Lanesborough, Leverett, Longmeadow, Lynnfield, Marion, Mashpee, Mendon, Middlefield, Middleton, Munroe, Monterey, Montgomery, Mount Washington, Nahant, New Ashford, New Braintree, New Salem, Norfolk, North Reading, Oakham, Otis, Pelham, Peru, Petersham, Phillipston, Plainfield, Plympton, Prescott, Richmond, Rowe, Royalston, Russell, Rutland, Savoy, Shutesbury, Southwick, Sunderland, Truro, Tyngsborough, Tyringham, Wales, Warwick, Washington, Wellfleet, Wendell, Westhampton, West Tisbury, Whately, Windsor, Worthington.—83.

The Board will forward to the local board of health of any place the postal cards necessary for reporting on application from such local board of health.

IV.

The following summary comprises the results obtained from the tabulation of the returns required by chapter 218 of the Acts of 1894, whereby the board of health of each city and populous town is directed to send to the State Board of Health an annual statement of the deaths in such city or town upon a blank form furnished by the State Board.

The whole number of cities and towns included in this list is eighty-five, of which number eighty complied with the statute. The total population of these cities and towns by the census of 1895 was 1,971,817. The number of deaths registered in these cities and towns was 37,828, and the death rate was 19.18 per 1,000.

Sexes. — The number of deaths of males was 19,109, or 50.5 per cent. of the whole number of deaths; and the deaths of females were 18,702, or 49.5 per cent.

Ages. — The deaths of infants under one were 8,634, or 22.8 per cent. of the total mortality; those of children under five years of age were 12,425, or 32.8 per cent. of the whole.

In conformity with the age distribution recommended by Körösi, the deaths of those whose ages were known were as follows: —

Ages.	Percentages.	Ages.	Percentages.
Under 1 year, ...	22.9	20-50, ...	25.7
1-20, ...	17.9	All over 50, ...	33.5

Months and Quarters. — The number of deaths in each quarter of the year is shown in the following table: —

	Deaths.	Percentages.		Deaths.	Percentages.
First quarter, ...	10,181	26.9	Fourth quarter, . .	8,712	23.0
Second quarter, . .	8,566	22.7	Date unknown, . .	10	-
Third quarter, . . .	10,359	27.4	Total, ...	37,828	100.0

The intensity of the seasonal death rate is shown in the following table, the method employed being explained on page 730, in Section III., relating to disease notification.

Seasonal Intensity of the Death Rate.

	Mean Daily Deaths per Month.	Mean Rate compared with a Standard of 100.		Mean Daily Deaths per Month.	Mean Rate compared with a Standard of 100.
January,	99.7	96.2	August,	126.4	122.0
February,	125.1	120.8	September,	109.6	105.8
March,	115.7	111.7	October,	95.0	91.7
April,	105.5	101.8	November,	94.8	91.5
May,	93.1	89.9	December,	94.4	91.1
June,	83.8	80.9	Annual mean,	103.6	100.0
July,	101.7	98.2			

Causes of Death. — The list of causes of death embraced in this summary includes those from the principal infectious diseases, including consumption, together with certain other groups of destructive diseases and those from violence.

The ratio of deaths to the living population is also presented, since this method of presentation, especially in a census year, constitutes a better method of indicating the incidence of each cause of death upon the living population than the ratio of the deaths from each disease or cause of death to the total mortality.

TABLE I.

Reporting Cities and Towns.	Population, 1895. (State Census.)	Reporting Cities and Towns.	Population, 1895. (State Census.)
Adams,	7,837	CHICOPEE,	16,420
Amesbury,	9,986	Clinton,	11,497
Andover,	6,145	Concord,	5,175
Arlington,	6,515	Danvers,	8,181
Athol,	7,364	Danvers Lunatic Hospital,	-
Attleborough,	8,288	Dedham,	7,211
BEVERLY,	11,806	EVERETT,	18,573
Blackstone,	6,039	FALL RIVER,	89,203
BOSTON,	496,920	FITCHBURG,	26,409
Braintree,	5,311	Framingham,	9,512
BROCKTON,	33,165	Franklin,	5,136
Brookline,	16,164	Gardner,	9,182
CAMBRIDGE,	81,643	GLOUCESTER,	28,211
CHELSEA,	31,264	Greenfield,	6,229

TABLE I — *Concluded.*

Reporting Cities and Towns.	Population, 1895. (State Census.)	Reporting Cities and Towns.	Population, 1895. (State Census.)
HAVERHILL,	30,209	PITTSFIELD,	20,461
Hudson,	5,308	Plymouth,	7,957
Hyde Park,	11,826	QUINCY,	20,712
LAWRENCE,	52,164	Revere,	7,423
Leominster,	9,211	Rockland,	5,523
LOWELL,	84,367	Rockport,	5,289
LYNN,	62,354	SALEM,	34,473
MALDEN,	29,708	SOMERVILLE,	52,200
Marblehead,	7,671	Southbridge,	8,250
MARLBOROUGH,	14,977	Spencer,	7,614
MEDFORD,	14,474	SPRINGFIELD,	51,522
Melrose,	11,965	Stoneham,	6,284
Methuen,	5,690	Stoughton,	5,272
Middleborough,	6,689	TAUNTON,	27,115
Milford,	8,959	Wakefield,	8,304
Millbury,	5,222	WALTHAM,	20,876
Milton,	5,518	Ware,	7,651
Natick,	8,951	Watertown,	7,788
NEW BEDFORD,	55,251	Webster,	7,799
NEWBURYPORT,	14,552	Westfield,	10,663
NEWTON,	27,590	Weymouth,	11,291
NORTH ADAMS,	19,135	Whitman,	5,744
NORTHAMPTON,	16,746	Winchester,	6,150
North Attleborough,	6,576	WOBURN,	14,178
Northbridge,	5,286	WORCESTER,	98,767
Orange,	5,361	Total,	1,971,817
Palmer,	6,858		
Peabody,	10,507		

Grafton, Holyoke, Montague, Westborough and West Springfield, no returns.

TABLE II.

Total Deaths, Deaths by Sexes and Age Periods, and Still-births in Cities and Towns having over 5,000 Inhabitants in Each, by Census of 1895.

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Deaths Under 1.	1-2.	2-3.	3-4.	4-5.	5-10.	10-15.	15-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	Over 80.	Age Unknown.	Rate per 1,000.
Adams,	129	66	63	-	4	34	6	2	-	3	5	3	6	14	7	7	7	11	16	8	-	16.46
Amesbury,	171	73	98	-	8	25	9	5	-	-	7	4	2	15	9	12	21	19	20	19	4	17.12
Andover,	103	58	45	-	1	14	3	1	1	1	1	-	9	5	5	5	10	10	20	16	2	16.76
Arlington,	97	51	46	-	7	14	7	-	3	4	1	1	4	9	9	6	5	13	12	9	-	14.89
Athol,	92	47	45	-	3	22	5	1	1	1	1	1	2	6	9	5	8	6	16	8	-	12.49
Attleborough,	127	70	57	-	5	23	3	1	3	-	1	3	6	14	9	8	13	10	19	13	1	15.32
BEVERLY,	191	89	101	1	13	29	10	2	3	1	10	5	2	15	17	12	15	20	24	25	1	16.18
Blackstone,	134	81	53	-	4	22	4	5	4	1	1	-	2	20	11	7	18	13	8	7	11	22.19
BOSTON,	11,329	5,831	5,498	-	607	2,580	689	306	198	162	356	103	299	1,122	1,154	1,062	1,015	982	834	467	-	22.88
Braintree,	82	40	42	-	1	13	5	4	4	3	3	1	-	2	5	6	3	13	10	10	-	15.44
BROCKTON,	486	238	248	-	30	96	24	17	9	9	14	14	14	50	36	41	41	39	50	32	-	14.65
Brookline,	245	120	125	-	9	34	13	8	4	2	10	4	6	20	21	11	29	20	29	34	-	15.15
CAMBRIDGE,	1,500	717	783	-	113	317	107	33	34	21	72	21	41	139	121	125	121	144	123	79	2	18.35
CHELSEA,	656	365	291	-	42	133	33	15	22	9	20	13	15	65	39	59	79	69	59	26	-	20.98
CHICOPEE,	369	214	155	-	22	139	28	10	4	1	8	5	3	39	27	16	26	29	21	13	-	22.47
Clinton,	176	94	82	-	20	39	7	4	3	5	6	2	9	17	17	12	17	19	12	7	-	15.31
Concord,	62	27	35	-	3	9	3	-	-	-	1	-	2	7	4	5	5	6	13	7	-	11.98

Danvers,	111	55	56	-	4	12	3	-	1	-	1	-	2	9	6	12	9	17	13	23	3	13.57
Danvers Lunatic Hospital,	118	66	52	-	-	-	-	-	-	-	-	-	2	8	12	18	21	23	25	8	1	-
Dedham,	145	79	66	-	6	18	6	2	4	1	5	2	3	14	6	8	14	25	20	17	-	20.11
EVERETT,	276	134	142	-	17	74	20	9	5	7	8	2	1	24	24	26	25	13	23	15	-	14.86
FALL RIVER,	1,902	997	905	-	169	688	†	†	†	†	68	‡	‡	164	123	115	144	131	71	43	-	21.32
FITCHBURG,	403	192	211	-	20	121	17	5	4	6	12	5	11	34	26	27	26	42	45	22	-	15.26
Framingham,	148	76	72	-	8	22	2	2	3	-	1	3	3	11	14	10	14	11	25	25	2	15.56
Franklin,	86	44	42	-	1	11	3	2	4	1	5	1	-	6	4	6	3	15	19	6	-	16.75
Gardner,	177	111	66	-	19	45	5	3	4	3	3	2	3	19	15	9	5	10	24	18	-	19.28
GLOUCESTER,*	423	205	217	1	34	119	20	14	4	6	15	8	10	45	25	27	29	32	42	26	1	14.99
Greenfield,	93	45	48	-	3	11	1	2	1	-	-	-	1	9	9	7	9	19	15	9	-	14.93
HAVERHILL,	521	242	279	-	31	125	17	17	6	6	18	6	7	47	50	29	51	53	47	42	-	17.25
Hudson,	82	45	36	1	2	18	8	1	-	-	2	1	2	7	3	6	2	13	9	10	-	15.45
Hyde Park,	203	103	100	-	14	44	12	3	6	5	7	2	4	19	21	12	13	22	20	13	-	17.17
LAWRENCE,	1,044	512	530	2	69	310	66	23	11	7	18	12	38	118	79	78	80	100	62	36	6	20.01
Leominster,	138	66	72	-	5	23	2	2	-	-	1	2	3	17	9	9	19	21	14	16	-	14.98
LOWELL,	1,857	943	914	-	170	566	123	49	28	22	40	26	47	172	169	142	141	130	141	61	-	22.01
LYNN,	1,086	523	563	-	52	214	42	18	18	20	54	21	29	97	100	80	115	94	100	82	2	17.42
MALDEN,	507	247	260	-	47	74	36	12	8	4	20	7	15	53	42	39	38	68	54	37	-	17.07
Marblehead,	152	81	71	-	4	21	4	2	3	2	6	2	4	6	9	8	20	23	23	19	-	19.81
MARLBOROUGH,	263	138	125	-	8	63	13	8	-	5	4	3	9	28	21	21	29	23	25	11	-	17.56
MEDFORD,	206	106	99	1	9	39	5	3	3	4	6	5	4	11	15	18	28	26	22	14	3	14.23
Melrose,	152	72	80	-	12	25	7	1	2	1	6	2	1	16	13	9	15	19	21	14	-	12.70
Methuen,	101	40	61	-	4	24	3	3	1	1	-	3	1	10	5	4	9	12	11	14	-	17.75

* One hundred and twenty-three deaths, of fishermen lost at sea, are not included in this total of 423.

† Two hundred and sixty-seven between the ages of one and five years.

‡ Eighty eight between the ages of ten and twenty years.

TABLE II. — Concluded.

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Deaths Under 1.	1-2.	2-3.	3-4.	4-5.	5-10.	10-15.	15-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	Over 80.	Age Unknown.	Rate per 1,000.
Middleborough,	100	43	57	–	1	11	2	–	1	–	1	2	3	7	5	7	13	18	15	15	–	14.95
Milford,	168	88	77	3	2	19	5	5	4	2	2	7	3	24	9	9	17	24	23	12	3	18.75
Millbury,	89	46	43	–	–	25	4	–	2	1	–	1	8	9	5	4	4	8	11	7	–	17.04
Milton,	67	41	26	–	6	8	4	2	–	–	3	2	2	7	4	2	6	9	13	5	–	12.14
Natick,	135	68	67	–	4	11	6	–	–	1	4	2	5	17	9	13	9	18	28	12	–	15.08
NEW BEDFORD,	1,055	528	527	–	60	330	55	25	16	11	35	12	32	68	65	59	98	103	85	61	–	19.10
NEWBURYPORT,	274	136	138	–	12	41	4	2	3	2	5	4	7	30	13	20	25	44	43	31	–	18.83
NEWTON,	448	211	237	–	29	93	25	10	4	–	17	11	17	23	34	35	31	48	57	43	–	16.24
NORTH ADAMS,	338	166	172	–	19	84	11	8	6	3	14	*	*	42	24	25	24	24	28	19	5	17.66
NORTHAMPTON,	253	122	131	–	11	60	8	4	0	2	0	6	1	23	21	26	25	31	36	10	–	15.11
North Attleborough,	86	45	41	–	5	13	1	–	–	–	3	–	3	10	11	7	11	11	10	6	–	13.08
Northbridge,	80	46	34	–	2	22	2	2	2	2	1	–	5	5	8	3	7	6	12	3	–	15.13
Orange,	71	28	42	1	3	10	4	2	–	1	–	1	3	5	5	8	3	5	12	12	–	13.24
Palmer,	159	83	72	4	8	34	10	13	12	5	14	1	2	9	7	5	8	14	16	8	1	23.18
Peabody,	217	98	119	–	2	28	11	4	3	3	3	1	11	22	18	20	30	22	18	23	–	20.65
PITTSFIELD,	324	151	173	–	30	61	5	6	1	3	4	6	8	35	36	30	29	42	41	17	–	15.83
Plymouth,	177	84	93	–	3	16	2	4	1	–	2	2	3	10	9	13	20	29	33	33	–	22.24
QUINCY,	329	173	156	–	34	69	18	7	5	8	12	6	14	26	34	26	22	27	29	20	–	15.88
Revere,	102	48	54	–	12	18	4	2	1	2	3	1	1	5	9	19	12	11	7	2	5	13.74
Rockland,	84	39	43	2	1	8	3	1	–	–	4	1	8	6	8	8	6	12	12	12	–	15.21

Rockport, ...	111	70	40	1	8	26	7	3	3	-	2	1	2	8	7	4	11	8	16	9	4	20.99
SALEM, ...	686	316	370	-	38	156	25	13	9	6	11	11	16	49	50	46	60	94	82	58	-	19.90
SOMERVILLE, ...	838	426	412	-	54	161	41	28	10	11	23	13	21	64	79	58	77	97	105	50	-	16.05
Southbridge, ...	180	89	91	-	3	37	7	4	2	-	6	1	5	12	10	12	15	16	18	19	16	21.82
Spencer, ...	109	52	57	-	9	10	7	4	3	4	3	4	8	7	12	8	9	18	7	5	-	14.32
SPRINGFIELD, ...	921	465	456	-	49	194	54	29	25	11	29	12	24	79	72	51	73	101	107	49	11	17.88
Stoneham, ...	109	53	56	-	3	16	3	2	-	1	1	2	4	8	5	6	16	18	16	11	-	17.35
Stoughton, ...	118	61	57	-	6	22	3	1	2	2	2	2	4	6	13	9	5	15	22	10	-	22.38
TAUNTON, ...	514	260	254	-	17	114	7	18	19	9	15	4	18	38	45	37	40	64	56	30	-	18.96
Wakefield, ...	153	70	83	-	4	20	6	1	1	4	4	3	12	9	10	8	15	23	25	12	-	18.42
WALTHAM, ...	323	166	157	-	15	71	8	4	1	3	11	9	10	29	33	25	23	33	33	30	-	15.47
Ware, ...	149	68	81	-	12	42	5	4	4	3	4	1	4	7	15	8	13	17	10	12	-	19.48
Watertown, ...	115	49	66	-	10	19	3	3	1	2	1	1	5	8	7	8	18	13	19	7	-	14.77
Webster, ...	112	59	53	-	2	20	9	3	3	1	8	2	3	15	6	11	3	10	9	9	-	14.36
Westfield, ...	182	93	89	-	11	21	9	3	1	4	6	3	6	22	11	12	19	31	21	13	-	17.07
Weymouth, ...	205	96	109	-	12	36	11	3	3	-	5	4	4	22	16	13	8	32	29	19	-	18.15
Whitman, ...	86	43	43	-	2	17	2	1	1	-	1	1	3	8	6	6	5	16	10	9	-	14.97
Winchester, ...	91	49	42	-	5	15	4	1	4	1	1	3	5	5	5	8	6	12	15	6	-	14.80
WOBURN, ...	300	147	153	-	16	58	25	9	5	7	29	7	7	27	19	20	24	25	24	14	-	21.16
WORCESTER, ...	1,827	930	897	-	104	408	87	35	32	14	60	19	55	172	153	189	165	201	147	90	-	18.50
Total, ...	37,828	19,109	18,702	17	2,233	8,634	1,878	861	599	453	1,166	464	969	3,481	3,208	2,997	3,297	3,724	3,457	2,180	84	19.18

* Twenty-one between the ages of ten and twenty years.

TABLE III.

Deaths by Months in Each City and Town having a Population of More than 5,000 by Census of 1895.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Unknown.
Adams,	7	10	11	6	6	5	7	24	18	17	11	7	-
Amesbury,	13	21	17	12	14	13	14	16	9	15	13	14	-
Andover,	13	7	16	12	9	7	7	10	3	3	7	9	-
Arlington,	5	7	11	9	11	6	9	12	8	7	3	9	-
Athol,	3	9	16	14	6	3	-	14	6	5	9	7	-
Attleborough,	11	8	17	10	11	5	7	16	13	14	6	9	-
BEVERLY,	16	17	17	10	16	14	9	28	15	16	17	15	1
Blackstone,	16	17	13	13	9	8	14	12	9	9	5	9	-
BOSTON,	960	1,028	1,007	900	891	783	918	1,131	978	946	858	929	-
Braintree,	10	9	11	9	6	7	1	4	8	8	3	6	-
BROCKTON,	46	46	56	55	29	28	28	47	38	38	38	36	1
Brookline,	23	26	20	23	16	10	10	20	28	21	26	19	-
CAMBRIDGE,	127	117	127	133	107	104	127	161	131	134	120	112	-
CHELSEA,	53	62	43	62	49	45	47	76	54	46	62	57	-
CHICOPEE,	24	29	31	23	23	24	53	41	33	28	35	25	-
Clinton,	19	21	16	13	11	7	11	16	22	12	17	11	-
Concord,	5	7	7	5	10	2	3	3	6	4	5	5	-
Danvers,	7	13	9	9	8	8	8	10	6	10	14	9	-
Danvers Lunatic Hospital,	9	7	8	7	12	11	7	13	12	12	9	11	-

Dedham,	15	12	9	20	16	13	9	10	12	8	9	12	-
EVERETT,	24	29	31	28	13	19	18	34	27	18	23	12	-
FALL RIVER,	128	149	185	149	116	124	257	202	187	148	124	133	-
FITCHBURG,	33	32	39	29	37	18	25	57	42	40	26	25	-
Framingham,	15	14	15	8	14	14	8	11	17	11	13	8	-
Franklin,	7	4	7	5	14	5	7	6	7	11	10	3	-
Gardner,	23	16	24	18	13	9	8	13	16	14	8	15	-
GLOUCESTER,	36	29	52	33	31	23	38	52	36	28	40	25	-
Greenfield,	7	10	6	12	6	7	5	10	7	8	6	9	-
HAVERHILL,	35	58	53	57	36	37	45	47	38	38	25	52	-
Hudson,	4	6	9	5	8	6	6	10	8	5	8	7	-
Hyde Park,	15	23	18	16	16	7	20	25	24	10	15	14	-
LAWRENCE,	75	97	93	75	73	87	118	103	101	80	66	74	2
Leominster,	10	15	14	10	14	6	9	14	12	12	15	7	-
LOWELL,	137	174	168	162	107	135	198	176	162	156	136	146	-
LYNN,	72	117	113	84	82	68	84	104	99	91	84	88	-
MALDEN,	36	48	56	46	39	35	32	52	37	47	39	40	-
Marblehead,	10	9	13	13	10	12	14	18	18	11	7	17	-
MARLBOROUGH,	18	27	20	27	34	10	19	23	19	19	20	27	-
MEDFORD,	14	24	20	15	16	15	11	22	21	20	14	13	1
Melrose,	7	20	9	22	10	14	11	16	11	15	9	8	-
Methuen,	10	16	12	6	8	8	6	10	10	4	7	4	-
Middleborough,	9	14	12	4	8	7	3	8	5	10	8	12	-
Milford,	20	19	16	14	14	13	8	11	16	12	17	8	-
Millbury,	6	11	6	8	9	3	9	9	12	4	5	7	-

TABLE III. — Concluded.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Unknown.
Milton,	7	7	9	6	1	2	5	7	7	7	5	4	-
Natick,	18	14	16	11	8	9	10	11	8	12	9	9	-
NEW BEDFORD,	80	90	117	68	81	73	85	136	74	71	100	80	-
NEWBURYPORT,	23	26	25	25	22	10	27	27	26	25	19	19	-
NEWTON,	35	44	29	35	39	30	42	42	43	43	36	30	-
NORTH ADAMS,	22	24	32	18	28	23	35	35	38	36	27	20	-
NORTHAMPTON,	19	25	22	12	24	16	15	43	20	24	14	19	-
North Attleborough,	6	5	12	7	9	10	6	8	7	6	2	8	-
Northbridge,	12	5	5	4	3	6	5	8	6	5	6	15	-
Orange,	8	5	10	10	3	5	4	7	6	3	6	4	-
Palmer,	10	17	23	11	16	12	13	19	5	6	13	9	5
Peabody,	14	18	23	24	22	12	13	28	14	14	16	19	-
PITTSFIELD,	22	44	28	29	23	23	24	33	32	19	25	22	-
Plymouth,	12	18	20	14	14	19	10	15	16	16	11	12	-
QUINCY,	35	22	29	26	31	23	28	34	26	24	31	20	-
Revere,	4	6	8	6	9	8	12	14	11	7	9	8	-
Rockland,	6	8	10	10	9	6	3	4	11	5	4	8	-
Rockport,	11	11	14	12	5	4	7	12	15	13	3	4	-
SALEM,	52	65	60	45	52	44	59	94	50	53	54	58	-
SOMERVILLE,	84	97	77	73	70	47	55	85	58	60	62	70	-
Southbridge,	12	15	16	15	14	18	9	21	19	16	11	14	-

Spencer,	5	16	8	9	12	9	5	11	8	3	14	9	-
SPRINGFIELD,	94	91	100	78	78	55	81	84	66	68	56	70	-
Stoneham,	6	12	11	7	6	5	12	17	7	10	7	9	-
Stoughton,	9	13	16	11	13	6	11	12	12	5	6	4	-
TAUNTON,	44	47	58	30	35	43	49	49	45	45	34	35	-
Wakefield,	12	20	16	16	8	9	12	11	12	8	13	16	-
WALTHAM,	24	30	26	20	28	22	23	42	27	31	31	19	-
Ware,	16	13	9	9	12	3	10	16	19	13	10	19	-
Watertown,	11	9	8	12	8	10	8	11	9	6	12	11	-
Webster,	14	15	7	5	4	11	2	13	14	10	10	7	-
Westfield,	11	21	25	14	11	11	20	21	8	11	13	16	-
Weymouth,	20	20	19	20	17	13	20	27	13	15	10	11	-
Whitman,	11	7	9	4	6	4	10	8	6	10	4	7	-
Winchester,	9	8	12	9	9	6	3	7	10	3	4	11	-
WOBURN,	16	23	24	23	25	16	25	42	40	17	30	19	-
WORCESTER,	165	158	200	147	142	107	147	168	158	156	134	145	-
Total,	3,092	3,503	3,586	3,166	2,885	2,515	3,153	3,919	3,287	2,944	2,843	2,925	10

TABLE IV.

Deaths from Specified Causes in Cities and Towns having More than 5,000 Inhabitants in Each, by Census of 1895.

	Consumption.	Measles.	Scarlet Fever.	Diphtheria and Croup.	Whooping-cough.	Typhoid Fever.	Cerebro-spinal Meningitis.	Erysipelas.	Puerperal Fever.	Influenza.	Malarial Fever.	Cholera Infantum.	Dysentery.	Diarrhœa and Cholera Morbus.	Pneumonia.	Bronchitis.	Diseases of the Heart.	Diseases of the Brain and Spinal Cord.	Diseases of the Kidneys.	Cancer.	Suicide.	Accident.	Unknown or Ill-defined Causes.	All Other Causes.
Adams,	18	-	-	6	-	10	5	-	-	-	1	13	-	-	9	4	9	5	8	7	1	3	-	30
Amesbury,	22	3	2	8	2	1	9	1	1	-	-	4	-	2	25	4	15	28	6	15	1	4	2	16
Andover,	11	1	-	-	-	-	-	-	-	-	-	1	-	-	7	6	14	11	1	3	-	3	-	45
Arlington,	12	-	-	5	-	5	-	-	1	1	-	1	1	2	8	4	8	19	4	3	1	5	2	15
Athol,	8	-	1	-	1	3	4	-	-	-	1	3	-	-	6	-	14	7	4	3	1	3	1	32
Attleborough,	15	3	12	6	-	7	1	1	-	-	1	4	-	-	11	-	6	23	12	4	1	3	17	-
BEVERLY,	13	-	-	16	-	3	4	-	-	-	-	2	2	1	24	3	13	-	14	8	-	4	-	84
Blackstone,	22	-	-	13	2	2	4	1	-	2	1	9	-	2	8	1	8	13	8	1	1	4	-	32
BOSTON,	1,349	19	114	654	47	163	15	34	14	69	6	500	43	84	1,268	439	870	581	377	-	77	444	62	4,077
Braintree,	5	-	-	5	-	-	5	1	-	1	1	3	-	-	16	2	6	10	1	4	-	3	-	19
BROCKTON,	72	1	5	13	4	10	6	1	3	-	-	20	3	4	59	11	23	20	16	9	6	2	-	198
Brookline,	23	-	1	15	-	3	-	1	-	-	-	10	-	-	16	10	19	-	7	18	1	1	-	120
CAMBRIDGE,	181	3	17	106	11	12	3	5	1	20	2	69	3	66	122	41	113	149	56	63	4	47	121	284
CHELSEA,	99	-	10	46	3	2	35	-	1	5	-	19	2	5	47	24	72	21	19	25	4	14	-	203
CHICOPEE,	30	1	5	7	3	4	1	-	-	7	1	52	2	2	30	10	27	18	13	7	2	7	-	140
Clinton,	29	4	-	3	4	6	9	-	1	3	-	7	5	3	15	2	12	16	6	5	3	3	-	40
Concord,	2	-	1	-	-	-	-	1	1	2	-	1	1	-	7	3	9	7	1	2	-	6	-	18
Danvers,	-	-	1	2	-	1	-	-	-	1	-	2	-	1	10	5	7	48	8	8	1	4	-	12
Danvers Lunatic Hospital,	18	-	-	-	-	-	-	5	-	4	-	-	5	8	15	1	7	38	4	2	1	-	-	10

Dedham, ...	12	-	-	7	1	-	-	-	-	-	-	2	1	3	12	3	14	8	8	5	1	6	-	62
EVERETT, ...	28	-	8	13	1	5	-	-	-	7	-	8	-	10	28	7	19	2	8	14	2	5	-	112
FALL RIVER, . . .	154	1	29	27	6	30	6	4	-	18	3	231	4	24	132	94	88	265	79	28	-	50	20	609
FITCHBURG, . . .	42	-	1	10	2	8	-	3	2	4	-	37	1	4	25	16	29	49	12	8	3	8	-	139
Framingham, . . .	16	1	-	2	1	2	4	-	-	-	-	2	-	-	16	5	22	6	4	9	-	5	-	53
Franklin, ...	4	-	-	5	-	1	4	-	1	1	-	3	-	1	5	6	15	7	6	4	-	1	-	22
Gardner, ...	24	2	2	-	2	3	2	1	2	9	-	11	-	6	13	5	7	7	6	3	2	5	7	58
GLOUCESTER, . . .	54	-	6	25	1	4	21	-	1	-	-	19	1	3	43	4	27	14	15	10	1	18	-	156
Greenfield, . . .	10	-	1	-	2	3	2	-	-	1	-	1	-	-	7	-	9	2	4	6	1	4	-	40
HAVERHILL, . . .	67	5	6	11	12	8	3	3	6	16	-	17	-	3	45	9	49	24	21	13	3	16	2	182
Hudson, ...	8	-	-	5	-	2	4	-	-	3	-	2	2	2	4	2	12	2	3	3	-	3	1	24
Hyde Park, . . .	17	-	2	7	2	1	9	-	-	1	-	8	1	1	8	3	15	-	4	9	1	16	-	98
LAWRENCE, . . .	70	4	12	9	3	16	4	1	4	-	-	96	4	6	59	15	53	54	28	32	7	35	6	524
Leominster, . . .	21	-	-	-	-	1	-	-	-	1	-	7	1	-	12	3	13	11	2	4	3	7	-	52
LOWELL, ...	158	1	4	53	10	33	7	1	4	26	1	218	4	4	158	77	154	258	62	47	7	59	2	509
LYNN, ...	122	-	25	42	8	13	44	2	1	26	-	38	2	12	85	33	89	7	33	35	5	19	-	445
MALDEN, ...	70	-	11	20	1	7	-	1	3	6	11	26	11	4	35	12	63	49	30	27	4	14	4	97
Marblehead, . . .	9	-	1	13	2	4	4	-	1	3	-	3	1	8	9	4	34	27	9	8	1	7	4	-
MARLBOROUGH, . . .	44	1	1	2	4	2	4	2	-	1	-	11	4	3	23	5	32	17	12	2	1	4	12	76
MEDFORD, ...	16	-	1	9	-	3	-	-	-	-	1	8	-	4	17	8	14	-	11	16	5	4	1	88
Melrose, ...	13	-	2	6	-	4	-	1	1	-	-	5	1	1	7	1	14	24	6	4	-	2	-	60
Methuen, ...	20	1	1	2	-	1	4	1	-	2	-	5	-	2	5	2	9	-	2	1	1	1	-	41
Middleborough, . . .	11	-	1	1	-	2	1	-	-	3	-	-	1	-	6	-	12	3	-	2	2	3	-	52
Milford, ...	22	1	-	6	1	2	2	3	2	1	3	7	2	2	29	6	14	19	14	1	-	3	-	28
Millbury, ...	14	-	-	2	-	-	-	-	-	-	-	7	-	-	6	8	7	1	4	-	-	3	-	37

TABLE IV. — Concluded.

	Consumption.	Measles.	Scarlet Fever.	Diphtheria and Croup.	Whooping-cough.	Typhoid Fever.	Cerebro-spinal Meningitis.	Erysipelas.	Puerperal Fever.	Influenza.	Malarial Fever.	Cholera Infantum.	Dysentery.	Diarrhœa and Cholera Morbus.	Pneumonia.	Bronchitis.	Diseases of the Heart.	Diseases of the Brain and Spinal Cord.	Diseases of the Kidneys.	Cancer.	Suicide.	Accident.	Unknown or Ill-defined Causes.	All Other Causes.
Milton,	5	-	1	3	-	2	2	-	-	1	-	1	-	2	2	3	6	-	2	2	1	-	-	34
Natick,	11	1	2	2	-	2	1	1	-	1	-	2	-	-	12	4	16	1	7	6	1	1	-	63
NEW BEDFORD,	97	1	5	30	4	9	4	5	-	4	1	66	4	6	78	21	94	10	49	37	-	2	11	517
NEWBURYPORT,	26	-	2	1	1	8	1	-	1	6	-	9	1	1	15	5	31	-	9	13	1	8	-	133
NEWTON,	44	1	1	21	-	3	2	-	-	7	1	16	3	2	42	15	40	59	12	21	4	8	-	146
NORTH ADAMS,	31	-	1	15	-	-	-	-	-	4	-	30	3	5	34	3	14	40	8	13	2	16	-	119
NORTHAMPTON,	36	-	-	3	5	3	-	-	1	5	-	11	4	3	14	10	21	13	8	6	2	6	-	101
North Attleborough,	16	-	-	1	-	1	-	-	-	4	-	2	-	-	2	4	7	12	6	4	1	3	-	23
Northbridge,	4	-	3	-	-	2	-	-	-	-	-	4	-	1	10	-	3	6	6	1	-	7	1	32
Orange,	10	-	-	1	3	-	2	-	-	1	1	-	1	-	-	4	6	-	-	2	-	3	3	34
Palmer,	5	-	25	19	-	2	2	-	-	3	-	12	-	-	19	3	9	12	6	6	2	2	-	32
Peabody,	22	-	1	3	-	5	6	1	1	4	-	8	-	1	9	3	19	6	14	8	-	-	-	106
PITTSFIELD,	46	-	1	-	-	3	-	1	-	1	-	21	-	8	22	12	37	34	2	7	1	17	-	110
Plymouth,	13	-	2	-	-	-	-	-	-	2	1	2	-	-	8	7	12	2	5	8	3	2	23	87
QUINCY,	56	-	4	17	2	7	16	-	1	1	-	18	-	1	20	8	30	25	9	15	2	11	1	85
Revere,	8	-	-	5	-	2	3	-	-	1	-	4	-	1	5	7	6	5	2	-	1	5	-	47
Rockland,	13	-	5	-	1	2	-	-	-	3	-	3	-	-	7	3	10	7	10	4	-	2	2	12
Rockport,	6	-	-	1	1	3	-	-	1	-	-	-	2	1	7	4	10	8	-	1	1	4	-	61
SALEM,	51	1	8	12	2	7	2	1	-	3	-	44	7	16	51	24	65	6	30	17	4	14	-	321
SOMERVILLE,	91	1	17	49	2	10	23	2	-	-	-	32	3	7	99	21	60	17	21	27	6	18	-	332

Southbridge,	24	1	-	2	-	1	-	-	1	1	-	19	-	-	11	9	9	19	10	7	-	4	43	19
Spencer,	13	1	1	1	-	2	1	2	-	-	1	2	-	1	10	-	7	1	1	6	1	-	-	58
SPRINGFIELD,	92	25	8	23	3	9	3	4	6	16	-	90	4	13	96	41	76	58	47	32	6	40	34	194
Stoneham,	23	-	1	-	2	1	1	-	-	-	-	2	2	-	6	8	12	13	4	10	-	1	21	2
Stoughton,	15	-	-	3	1	-	4	-	-	7	1	5	-	1	11	1	11	15	4	4	-	2	-	33
TAUNTON,	44	-	1	27	-	2	11	2	-	-	-	17	-	1	26	6	20	4	11	8	2	15	-	317
Wakefield,	11	-	-	2	-	2	14	1	-	-	-	8	2	1	9	3	23	11	5	6	-	6	-	49
WALTHAM,	59	-	3	2	-	6	-	1	3	2	2	7	-	13	39	8	28	34	13	16	2	13	-	72
Ware,	10	1	-	9	5	1	3	-	3	-	-	11	-	13	17	7	11	2	6	1	-	1	-	48
Watertown,	12	-	1	3	-	-	4	2	-	-	2	1	1	-	13	2	14	3	12	6	-	3	36	-
Webster,	15	2	-	8	-	2	-	-	3	1	-	10	1	4	6	1	14	10	4	3	-	4	1	23
Westfield,	16	-	4	12	2	6	4	-	1	3	-	8	1	1	16	1	29	26	9	9	-	9	8	17
Weymouth,	35	-	3	6	5	4	-	1	-	1	1	6	2	2	15	9	23	36	6	7	2	1	20	20
Whitman,	12	-	1	2	1	-	3	-	-	1	-	1	-	-	16	1	13	4	1	3	-	1	-	26
Winchester,	8	-	3	3	1	1	-	1	-	-	-	4	-	3	9	1	13	7	1	5	1	1	-	29
WOBURN,	15	-	18	15	1	5	19	-	-	-	8	13	1	5	21	7	26	2	7	6	1	9	-	121
WORCESTER,	228	1	5	70	28	25	-	9	8	14	-	127	7	15	184	50	153	246	77	76	8	49	1	445
Total,	4,178	88	410	1,553	205	525	357	108	81	341	52	2,108	157	411	3,453	1,214	3,044	2,624	1,372	881	210	1,146	469	12,807

	Homicide.
Boston,	22
Lawrence,	2
Natick,	1
Newburyport,	2
Northampton,	1
Pittsfield,	1
Springfield,	1
Worcester,	1
Total,	31

	Glanders.
Boston,	1
Malden,	1
Total,	2

	Actinomycosis.
Cambridge,	1

TABLE V.

Causes of Death.	Deaths.	Mortality per 10,000 of the Population, 1895.	Causes of Death.	Deaths.	Mortality per 10,000 of the Population, 1895.
Consumption, . . .	4,178	21.20	Dysentery, ...	157	0.80
Measles, ...	88	0.40	Diarrhœa and cholera morbus.	411	2.08
Scarlet fever, . . .	410	2.10	Pneumonia, . . .	3,453	17.50
Diphtheria and croup, .	1,553	7.80	Bronchitis, ...	1,214	6.15
Whooping-cough, . .	205	1.04	Diseases of the heart, .	3,044	15.40
Typhoid fever, . . .	525	2.60	Diseases of the brain and spinal cord.	2,624	13.30
Cerebro-spinal meningitis,	357	1.80	Diseases of the kidneys, .	1,372	6.96
Erysipelas, ...	108	0.55	Cancer, ...	881	4.47
Puerperal fever, . . .	81	0.41	Suicide, ...	210	1.06
Influenza, ...	341	1.70	Accident, ...	1,146	5.80
Malarial fever, . . .	52	0.26	Unknown or ill-defined causes.	469	2.38
Cholera infantum, . .	2,108	10.70			

HEALTH OF TOWNS.

HEALTH OF TOWNS.

The following digest contains such extracts from the annual reports of the local boards of health of cities and towns as pertain to matters of sanitary importance in the different municipalities from whose reports they are quoted.

The most notable point observed in these reports is the unanimity with which local boards have entered upon the work of controlling the spread and limiting the mortality from diphtheria by the introduction of the use of antitoxin. In nearly all the cities and large towns and in many of the smaller towns the use of this agent has become quite general, and the success attained by such use appears to have been uniformly good. It is to be hoped that, along with the gain derived from this additional aid to the sanitary authority, the usual and quite important measures of isolation, notification, disinfection and general municipal cleanliness will not be slackened in the least degree.

Attention is especially called to the statement in the extract from the report of the Concord board of health relative to the authority or jurisdiction of a local board of health over a public institution existing within the limits of the area over which the local board of health acts. There are at present many such institutions and establishments located in the different cities and towns, and their number is annually increasing. A full statement of the question involved has been published by the authorities of the State Reformatory at Concord.

Health of Towns.

Amesbury.

The election of the board of health was illegal. The duties of the board reverted to the selectmen, and they availed themselves of a statutory provision and appointed an agent.

The vault and cesspool method of caring for the sewage has been in general use so long that some sections of the town are saturated with filth, so that in some instances vault fluids have leaked through into adjacent cellars.

A few cases of tuberculosis have been discovered in our town, and the animals quarantined and slaughtered by order of the State officers. Every dairyman should have his herd tested, for it will be only a few years when consumers of milk will demand a certified article.

Diphtheria has been unusually severe, there having been 24 cases, 9 of which were fatal. Up to October 18 there have been 8 cases, with 4 deaths; since the above date there have been 16 cases, with 3 deaths. In 12 of these 16 cases antitoxin was used, with only 2 deaths; in 4 of these 16 cases antitoxin was not used, and one died. In one of the fatal cases where antitoxin was used the case had advanced two weeks before the use of the drug, and the other case was advanced from Tuesday to Friday. It is necessary to use antitoxin early in the development of the disease, to get the best results. A supply of antitoxin is constantly kept on hand by this board, and in cases of poor families is furnished free of charge.

Andover.

During the year twenty-six cases of nuisance have been investigated by the board. Advice in regard to the location of six cesspools has been given. Two examinations and certificates for plumbers have been received, and one permit granted to keep a boarding-house for infants.

The various slaughter houses and rendering establishments have been under the supervision of your Board, and have been visited frequently.

Arlington.

Our town the past year has been remarkably free from the prevalence of epidemics of contagious or other diseases.

The board has given prompt attention to all calls for its services to abate nuisances and remedy sanitary defects.

In most cases parties interested have readily responded to requirements of the board, with results satisfactory to all concerned.

Attleborough.

The present board early in the year published a notice inviting all citizens who knew of any nuisance or any condition which they deemed a nuisance or a menace to the public health to notify the board in writing. Owing, doubtless, to this fact, it is safe to say that there have been more cases of this nature reported during the past year than in any preceding year in the history of the town. The board has made a special effort to remedy an evil which we believe has, in the past, been the cause of much infectious illness in our town.

Of the animals killed during the past year in town for beef purposes, twelve have been found to be afflicted with tuberculosis. Some of these animals, apparently healthy, have been used as milk producers. We wish it were possible to require every milk producer to have his herd examined before he is allowed to dispose of a single quart of milk.

Ayer.

Four cases of typhoid fever were contracted out of town, three occurred in families using water from old wells, five were of unknown origin.

Belmont.

The town has been remarkably free from contagious diseases during the past year. Only one death occurred during the year from contagious disease, that being from diphtheria.

The completion of the main line of the metropolitan sewer in the summer of 1895 was a matter looked upon by the board of health as one of great importance toward promoting the good sanitary condition of the town. This completion necessitated the adoption of plumbing regulations, which were accordingly drawn up by the board, accepted by the town and incorporated as a part of its by-laws.

Billerica.

We have from time to time inspected wells, cesspools and vaults and made analyses of drinking water, both in the Centre and North villages, and have advised such cleansing and changes of construction as seemed to be demanded in the interest of health. We cannot too earnestly call attention to the importance of keeping the drinking water free from all pollution, by drainage, from cesspools or vaults.

Blackstone.

During the year the board attended to all complaints made to them, and in most cases with good results; but in a few cases the persons to whom instructions to abate nuisances were given did not promptly attend to them, either from neglect or for the purpose of making themselves thoroughly disagreeable. All cases have been properly examined, however, and such suggestions made as are likely to obviate future cause of complaint.

Boston.

The total number of deaths for the year was 11,329, a decrease from the previous year of 191 deaths. The population, as estimated at the end of the year, is 501,083. The death rate for the year, as calculated on this population, is 22.60 per 1,000 inhabitants. This rate is less by .38 than that of the previous year, and the lowest since 1889.

There were 229 less deaths from diphtheria than in 1894, although the number of cases of diphtheria reported was largely increased on account of the larger number discovered among the pupils in the public schools by the medical inspectors of schools, and the bacteriological tests in the otherwise unrecognized cases. The ratio of deaths to the number of cases of diphtheria reported has been reduced by more than one-half.

Very complete tables are published, showing the mortality from infectious diseases in Boston in 1895, by months, sex, nativity, color and ages.

Bacteriology.

The bacteriological work in culture diagnosis of diphtheria, begun by the board of health in October, 1894, has been continued at the Harvard Medical School Laboratory under the charge of Prof. Harold C. Ernst.

Medical Inspection of Schools and Supervision of Contagious Diseases.

The inspection of schools, which was commenced in November, 1894, and described fully in our last annual report, has been followed through the year with excellent results. The schools have been visited daily, and all children who have complained of illness or appeared to the teachers to be ill have been examined by the visiting physician, who, in all cases, advises the teachers what to do with the pupil. This work has now been in progress for fourteen months, and it has demonstrated the fact that there are not only many cases of contagious diseases to be found in the schools, and which require early recognition and removal, but that there are large numbers of school children whose illness and whose disposition by the teacher require the decision of a competent physician.

For the fourteen months ending Dec. 31, 1895, 16,790 pupils were examined, 10,737 of whom were found to be ill; 6,053 were found not to be ill, and 2,041 of these were too ill to remain in school for the day.

Seventy-seven cases of diphtheria, 28 cases of scarlet fever, 116 of measles, 28 of chicken-pox, 69 of pediculosis, 47 of scabies, 47 of mumps, 33 of whooping-cough and 8 of congenital syphilis were found in children sitting in their seats spreading these diseases to other children. The remaining 10,372 sick children were suffering from a large variety of other diseases.

Commendable efforts were made by the board in the direction of a general improvement of the sanitary condition of the school-houses of Boston. In view of the fact that contagious diseases may easily be spread in the schools through the medium of infected books, pencils, sponges, slates, desks and other surfaces of the school-room, handled or used by the children, the following recommendation was made to the school committee in 1894 : —

To the Honorable School Committee, City of Boston.

Gentlemen : — The board of health begs respectfully to recommend that the desks, chairs, window-sills, wainscotings, doors, door-knobs and such other surfaces as are likely to be handled by the children within the school buildings be carefully rubbed with cloths or sponges, wet with a solution of corrosive sublimate (one part of corrosive sublimate to one thousand parts of water), as often as every Saturday during the school year; that the floors of the school-houses be well covered with sawdust thoroughly wet with the same disinfecting solution, at least once a week, and the sawdust swept up and burned; that the use of all slates, slate-pencils and sponges for slate use be discontinued, and that paper and lead-pencils be substituted.

The disinfection of books is scarcely practicable except by fire, and the board would recommend, whenever it is known that a book has been handled by a pupil who was, at the time, affected with a contagious disease, or the book is otherwise much soiled, it be immediately burned.

Very respectfully,
The Board of Health,
By S. H. Durgin, *Chairman.*

The following action was subsequently taken by the school committee : —

Report of Committee on Hygiene and Physical Training.

The committee on hygiene and physical training, to whom was referred — October 27 — an order "that the committee on hygiene and physical training consider and report what action, if any, can be taken by this board to disinfect, or render aseptic, the school-books used in the schools," report that careful consideration was given to the order, but no practical method could be found.

Up to this time nothing but fire is considered a sure disinfectant, therefore the books could be rendered aseptic only by destruction at stated intervals. As this committee do not feel at liberty to recommend this action, they have no suggestion to offer concerning the disinfection of books; however, that it will be entirely practicable to discontinue the use of slates and slate-pencils, and the necessary accompaniment, sponges. There are three good reasons why the use of slates and slate-pencils should be discontinued : —

First, a light gray mark upon a slightly darker gray surface is more or less indistinct, and trying to the eyesight.

Second, the resistance of the hard pencil upon the hard slate is tiring to the muscles, and the resistance, to which the muscles are trained by the use of slates and slate-pencils, must be overcome when beginning to write with pencil or pen upon paper.

Third, and last, but not least, the use of slates, slate-pencils and sponges is a very uncleanly custom, and leads to and establishes very uncleanly habits.

The committee also deprecate the custom of the daily distribution and regathering of lead-pencils, for the reasons which must be apparent to all after a moment's consideration. The pencil not infrequently finds a resting-place between the teeth and lips, and it is hardly to be supposed that the same pencil will be given to the same pupil the next day.

The committee, therefore, recommend the passage of the following orders: —

Ordered, That the use of slates and slate-pencils and sponges be discontinued, and that paper, lead-pencils and rubber erasers be supplied in their places.

Ordered, That lead-pencils and erasers be given to each pupil at the beginning of the term, to be retained by the pupil for his sole use during the school year.

June 25, 1895.

Ordered, That the committee on accounts be requested to direct janitors to cover during the summer vacation all the floors of school-houses with sawdust wet with a solution of bichloride of mercury (one part of bichloride of mercury to three thousand parts of water), and sweep the sawdust before it becomes dry; also sponge off all chairs, desks, window-sills, wainscotings, doors and door-knobs with a solution of the same strength, and wipe off with a wet cloth before they become dry. All applications may be made with a sponge or cloth mounted upon a handle or stick, so that the hands need not be put into the solution.

Diphtheria.

A detailed account of the work of culture diagnosis of diphtheria and the production of antitoxin is presented.

The total examinations made for the whole period have been 8,644; the lowest daily average for any month was 11, during August and September, and the highest 33, during December, 1895. The daily average of November, 1894, was 13; the daily average of November, 1895, was 28; of December, 1894, 27; of December, 1895, 33, — showing a marked increase in the use of this method of diagnosis by the profession.

The total number examined in November, 1894, was 397; in November, 1895, 835; in December, 1894, 823; in December, 1895, 1,023.

There were sent in 402 cases showing no growth, and these are to be neglected, leaving 8,242 cases in which the results were more or less satisfactory. Of these, 1,717 were found to contain the bacilli of diphtheria, a percentage of a little less than 21.

The Production of the Antitoxin of Diphtheria.

The preparation of this material was begun in December, 1894, and has been vigorously and successfully prosecuted since that time. Some time was consumed in getting together the necessary apparatus, animals and assistants. The cultures have all been made and the injections of the horses have been carried out at the place originally selected on Gallop's Island.

The following table has been prepared, which includes the totals from all the horses in the time that they have all been immunized, *i.e.*, from the last of August, 1895: —

	Cubic Centimeters of Serum.
Horse IV.,	2,500
Horse V.,	3,500
Horse VIII.,	1,700
Horse IX.,	2,000
Horse X.,	3,500
Horse XI.,	2,500
Total,	15,700

or nearly 1,000 cubic centimeters a week.

There have been returned at this date (Jan. 15, 1896) reports of the results of the use of the antitoxin supplied by the board in 743 cases, divided as follows: —

Recoveries,	550
Deaths,	97
Total,	647

giving a mortality of a shade under 15 per cent., which is remarkable when compared with the general mortality of this disease, never under 27 per cent. in Boston and 27.06 per cent. in 1894.

To the foregoing are to be added 96 cases in which the serum was used for immunizing, making a total of 743 cases in all.

It has seemed to be interesting to work out the percentage of mortality in private practice, so far as it is shown by our returns. Of cases in which the antitoxin of your board has been used out of the hospitals, there have been reported: —

Recoveries,	72
Deaths,	7
Total,	79

which gives a mortality of 8 per cent.

Garbage Disposal.

If this material should be disposed of in the kitchen there would no longer be any danger of a public plant for the cremation or reduction of garbage in any residential district of the city; there would be no more swill-carts in the streets; there would be fifty thousand less swill-barrels in the back yards, and a saving of two hundred thousand dollars annually to our city treasury.

House-to-house Inspection.

Recapitulation.

Whole number examined,	366
Bad odors found,	116
Defective drains found,	122
Lack of traps found,	77
Offensive vaults found,	1
Damp or unclean yards,	11
Damp or unclean cellars,	19
Using furnaces,	107
Furnaces without proper air supply,	14
Using steam heat or hot water,	8
Water-closets found,	364
Old style or faulty water-closets found,	64
Offensive water-closets found,	34
Ventilation to soil-pipe or drain found,	178
Offensive cesspools found,	14
Percentage of defective drains,	33.33
Percentage of defective trapping,	21.04
Percentage of unventilated drains,	51.37
Total number of nuisances abated,	11,679

Disinfection after Infectious Diseases.

Diphtheria,	3,450
Scarlet fever,	1,486
Phthisis,	6
Measles,	11
Total,	5,095
Rooms disinfected,	10,155
Grand total of disinfections,	56,888

Materials Used.

Bichloride of mercury (pounds),	1,575
Chloride of lime (pounds),	36,875
Sulphur (pounds),	44,899
Copperas (pounds),	3,150
Muriatic acid (carboys),	12
Houses ordered vacated,	112

Public Baths, Number of Bathers in June, July, August and September.

	1894.	1895.
Total men and boys,	860,944	589,779
Total women and girls,	221,731	177,046
Total of both sexes,	1,082,675	766,825

The subject of maintaining bath-houses all the year round was the subject of a special recommendation by His Honor the mayor in his inaugural address to the city council, and a special commission has since been appointed by him to consider the subject, and make such recommendations with a view to establishing such accommodations as may be deemed expedient. The supplying of public bathing facilities during the winter as well as during the summer months has the cordial approval of the board of health, as being in the line of promoting the public health.

Examination of Plumbers.

The examining board held 44 meetings and examined 258 candidates for plumbers' licenses; 93 were for master plumbers' licenses, and 50, or 52 per cent., passed the examination and were licensed; 165 were examined for journeymen plumbers' licenses, and 106, or 64 per cent., passed the oral examination and were notified to report at the shop for a practical test. Of the 106 candidates who passed the oral examinations, 77 passed successful examinations in the shop and were given licenses.

Lying-in Hospitals.

During the year 423 confinements have taken place in the licensed hospitals, and no deaths have been reported.

Stables.

There were 248 applications, and 198 were granted.

Prosecutions.

During the year there have been 30 prosecutions for violations of various health laws. In these cases there were 25 convictions, 2 acquittals, 2 were *nol-prossed* and 1 is still pending.

Of the convictions, perhaps the most important was that of a physician for failing to report a case of contagious disease which he had been called to attend. In this case a fine of fifty dollars was imposed in the lower court, and, after an appeal and trial before a jury, the judgment of the lower court was affirmed, and the fine increased to one hundred dollars.

The physicians of the board examined 39 cases reported as small-pox, none of which proved to be such.

The bodies of 454 persons dying without a physician were also examined, to determine the causes of death.

Animals killed at Abattoir.

Cattle,	25,814
Calves,	14,141
Sheep,	77,906
Swine,	470

Animals condemned.

	Number.	Weight.
		Pounds.
Cows,	52	22,864
Steers,	2	1,540
Bulls,	1	630
Calves,	9	372
Sheep,	1	30
Parts of animals,	–	4,000
Total,	65	29,436

Diseases found among Animals after having been killed and dressed at the Abattoir.

Diseases.	Cattle.	Calves.	Sheep.
Tuberculosis,	49	–	–
Actinomycosis,	7	–	–
Septicæmia,	2	–	1
Puerperal fever,	2	–	–
Bruised,	1	–	–
Immatured,	–	9	–

Tuberculosis.

The following table shows the percentage of tuberculosis in cattle killed at abbatoir with the intention of being used for food: —

Class of Animals.	Number received.	Tuberculosis.	Percentage.
Whole number of all kinds,	25,814	49	0.189
Cows from eastern States,	1,949	47	2.41
Bulls from eastern States,	157	1	0.63
Steers from eastern States,	–	–	–
Cows from Buffalo,	536	1	0.18
Cows from western States,	1,421	–	–
Steers from western States,	–	–	–

Under the head of "cows from eastern States" is understood those animals from all of the New England States, including Massachusetts.

Inspection of Cattle.

In accordance with the regulations of the board of health and an act of the Legislature, the work of inspection of cows kept for the production of milk has been continued during the past year. With one or two exceptions all cattle which upon inspection have shown any symptoms of tuberculosis have been subjected to the tuberculin test, and all animals which have shown a reaction to such test have been quarantined, and the State Board of Cattle Commissioners notified.

BROCKTON.

The board is of the opinion that final disinfection after contagious diseases, which is required under the Public Statutes to be done to the satisfaction of the board, should be done by the board itself. It is the intention of the board the coming year to ask for an appropriation to carry out this work, and to employ some person to disinfect all premises and articles which, in its opinion, have been infected.

The following is a list of some of the principal complaints and nuisances investigated during the past year: —

Defective cesspools,	127
Defective vaults,	115
Filthy yards,	143
Filthy cellars,	24
Bad drainage,	33
Animals buried,	43

BROOKLINE.

Nine cases of typhoid fever, several of which, if not all, were found on investigation to have been contracted away from home, is an exceedingly small number for a population of over sixteen thousand, and is the best possible evidence of the care taken to maintain the purity of our public water supply.

The board of health hospitals have been kept in readiness throughout the year, and have been used for the efficient isolation and care of 2 cases of scarlet fever and 21 cases of diphtheria. The only death occurring in the hospital was the case of a feeble little child, ill with both measles and diphtheritic croup, the latter disease being well advanced and beyond control when admitted to the hospital.

It is gratifying to be able to state that during the diphtheria epidemic in Brookline and the surrounding cities and towns in October, November and December, of the 18 patients admitted to the hospital, all going with their parents' approval or consent, and all of whom received one or more injections of antitoxin (in most cases furnished by the State Board), all re-

covered. The number of diphtheria patients reported in the town during the same time, many of whom also had antitoxin, was 42, of which number 9 died, or 21.4 per cent. During the epidemic and since, antitoxin has been furnished free by the board, on application, to physicians having patients who could ill afford to pay for it. The State Board antitoxin was supplied when available, otherwise Behring's, and excellent results were reported from both.

The value of the bacteriological test as a means of certain diagnosis, which is required to be made in all diphtheritic cases before they are released from quarantine, has been emphasized by the recent experiences here.

The need of improved public bathing facilities and of a new public swimming-bath, recommended in previous reports of this board as an important sanitary measure, has been recognized by the town, and the necessary steps for securing a new public bath-house, first-class in every respect, have been taken.

In the same pamphlet with the report of the board of health are published the reports of the inspectors of milk and of animals, also those of the sanitary inspector and of the town clerk on vital statistics. The report of the milk inspector presents the results of analysis of each one of more than two hundred samples, together with the names of the dealers.

Cambridge.

Number of inspections made,	2,313
Number of subsequent inspections,	4,569
Total,	6,882

Hospital.

In the year 1894 the prevalence of scarlet fever in Cambridge was greater than in any year since notification of diseases dangerous to the public health was made obligatory, and in the present year the same has been true of diphtheria.

Had there been during these years a suitable hospital for the reception of cases of these diseases at the disposal of the board, many cases might have been prevented and lives been saved. In the absence of such a hospital it has been the duty of this board (P. S., chap. 80, sect. 40), in view of the great prevalence of diphtheria in the city, to utilize as far as possible the small ward in the Cambridge Hospital for the reception of cases of this disease. They have also been compelled to use for a short time the Cottage Hospital on the almshouse grounds. While the accommodations afforded by these hospitals have not been adequate to the needs of the city, they have yet been of very great value in enabling us to check the spread of this disease. In these two hospitals combined 62 cases of

diphtheria have been cared for this year at the public expense; of this number, 9 died. The Cambridge Hospital also treated 9 private cases, among which there were no deaths. The fatality among the hospital cases was, therefore, 9 out of 71, or 12.7 per cent. Of these fatal cases it should be said that 3 were practically past hope when they reached the hospital, and expired shortly after reaching it.

Disinfection.

We are endeavoring to so train certain of our employees that the work of house disinfection may be intelligently and effectively done by them and under their direction, they being authorized to require the co-operation of the householders for such matters as can and should be done by the latter.

Bacterial Examination.

We are most clearly of opinion that the protection of the public health demands that this work, begun by this board during the past year, should be unremittingly carried on.

Schools.

What has thus far been accomplished is to prevent the return to the public schools of children who have had contagious disease, while they are yet capable of transmitting it, and to prevent the attendance at such schools of children from families wherein cases of such disease exist. This has been of the utmost importance; but there yet remain the following measures to be adopted before it can be said that the city has reasonably done its duty in the premises: —

1. The extension of the present system to the private and parochial schools of the city.
2. Establishing a system of school inspection by physicians appointed by this board, with a view of detecting cases of actual disease among the children present in school, and their prompt elimination.
3. Much greater attention than has heretofore been paid to the matter of cleansing of the school-rooms and school-houses.

We have already succeeded in partially extending this system to the parochial schools; *i.e.*, notification of contagious diseases affecting the attendance of their scholars is now sent to those in charge of such schools.

Canton.

Owing to an informality in the election of the board of health, the duties of the office devolved upon the selectmen.

Twenty-three complaints of nuisances have been filed, and each was at once abated.

Chicopee.

Epidemic influenza, or "grippe," which appears to have become an annual visitor, was the principal acute disease affecting our people during the winter and spring, but, aside from its fewer victims and somewhat lessened severity, presented no new symptoms worthy of note.

Eight cases of typhoid fever is a good record, compared to the years previous to 1893, when our city stood among the first in the Commonwealth as a habitat of this disease. Here certainly is a testimonial to the greater cleanliness of the city, as well as to our better water supply. Some difficulty has been experienced in getting physicians to report cases of typhoid to the health department, though this is distinctly required by the regulations. Accordingly the board had mailed to every physician in the city a postal card *stating that typhoid fever must be reported*, that this was necessary not only for statistical purposes but also to enable the health authorities to investigate the sanitary conditions of the places where it occurred, and that co-operation in this matter would be insisted upon. Since then, so far as the board is aware, all cases have been promptly reported.

As our population increases, the need of some systematic and reliable method of garbage collection becomes more pressing.

Clinton.

The board has made arrangements with the State Board of Health for the keeping of a supply of antitoxin on hand for the use of physicians in this and adjoining towns. By this means several cases in Clinton and Bolton have been supplied earlier than could have been the case under the former method, and it is believed with marked benefit.

Cohasset.

Complaints having been made of the impure condition of James Brook during the summer, the board of health carefully investigated the matter and did what they could to abate the nuisance. Believing the cause to have been the flowing of sewage into the brook, they requested all persons who convey the overflow of their cesspools thereto to cease doing so before April 1 next. A cheerful compliance with the above request will prevent the repetition of the nuisance the coming summer. The board have, as a precautionary measure, caused the brook to be cleaned and dug out from the bridge on Pleasant Street to its entrance to the harbor.

Concord.

The plumbing in thirty-six houses has been inspected and passed during the year. This work is all new, being either in new houses, or new work in old houses. We can truthfully say that that part of the labor of this

board is worth all it costs. In our opinion this is most important, and it will be found to be especially so if a system of sewage disposal is established in the near future. By the agent's report it will be seen that he has inspected more places than ever before, and in the most thorough manner.

The agent was refused permission to inspect the premises in one case. The deputy superintendent of the Massachusetts Reformatory, acting under instructions from the superintendent, took the ground that none of the houses occupied by the officers and owned by the Commonwealth were subject to any inspection by the local board of health. After considerable correspondence with the superintendent and the prison commissioners, an opinion was finally obtained from the Attorney-General of the State. The opinion is expressed that, as the superintendent had sole control of the reformatory, and as the houses of the officers were a part of the institution, the local board of health could not inspect them without interfering with the discipline of the prison. It being admitted on our side that we had no rights inside the prison walls; the Attorney-General thought that it would be impossible clearly to draw the line, and hence that neither we nor the State Board had any right to inspect the property. We have rested our case there. Our only alternative is to go to the Legislature and try to get a bill passed, allowing local boards of health to inspect State property used as dwellings, wherever it may be found within their jurisdiction.

It seems to us decidedly inconsistent that, as a local board, we should not have the same rights to inspect the houses of the Commonwealth as we have to inspect those of a private individual; for, if an epidemic should break out, or even if an isolated case of contagious disease should appear in one of the houses owned by the Commonwealth, the local board of health would certainly be called upon to fumigate the building and take other measures to abate the trouble, and, if so, why should we not have the power to inspect the houses at first, and see that they are kept in a healthy condition?

Cottage City.

As there had been considerable agitation and discussion concerning the unsatisfactory condition of Lake Anthony for some time previous to the annual town meeting, at which place it was again brought under discussion, the board felt it their duty to bring the lake into as clean and healthful a condition as possible, and at the same time render it an ornament to the town. The board, therefore, consulting with several competent persons as to the most expedient and satisfactory way to obviate this difficulty, decided to close the opening to the lake, thereby changing the water from salt to fresh, and thus killing the peculiar growth of grass with which the lake was filled, and by its decay causing a disagreeable odor, rendering the shore unsightly and making the lake totally unfit for boating. We closed

the lake by the construction of a dam across the opening, by which means the water was changed from salt to fresh. We succeeded by this means in destroying the grass, as evidenced by the large quantities which came ashore during high winds, and the accumulation thus coming ashore was raked up and carted away as soon as possible.

Danvers.

There was an epidemic of measles during the spring and summer, probably many more cases than were reported, as the disease is often so mild that no physician is called to attend.

The cases of diphtheria were treated with the new remedy, diphtheria antitoxin, of which so much has been expected. We have thought it advisable to keep an antitoxin syringe and a supply of antitoxin on hand, so that any physician in town can obtain them of the board of health at short notice.

The time is not far distant when the town must adopt a general sewage system, which is the only satisfactory way of disposing of the sewage in thickly settled parts of the town.

Dedham.

The town is to be congratulated, both in being able to obtain so excellent a service as will be hers when the metropolitan sewer is completed, and also in having the prospect of obtaining so speedy a relief from the extremely unsanitary conditions now prevailing in her midst. Upon the completion of the trunk sewer the town must construct a system of lateral or branch sewers to connect therewith, and some provision must be made for this purpose in the near future.

The keeping of swine in the town and the teaming of swill and offal through the streets seem to be an annual source of difficulty and nuisance.

Everett.

In July it came to the knowledge of the board that there were some unreported cases of diphtheria. The attending physician was prosecuted and fined fifty dollars in the district court. In these cases the probable source of infection was an old lounge that had been brought from out of town and upon which a child had died with diphtheria. It was put out in the yard, and the children had used it. Very soon there were 7 cases and 1 death in the neighborhood. Possibly there were other mild cases that were not recognized. There has been a number of cases since in that locality. In a number of instances we are quite sure that the disease has been contracted from infected persons from out of town or by children visiting infected houses in other places. In one case a child was sent here because its brothers had the disease. This child remained well, but a child in the

family where it came to stay developed a positive case of diphtheria. We have had a number of cases that have shown the great advantage of making bacteriological examinations. Of 26 cases where antitoxin was used early there were but 2 deaths (one of them occurred at the end of the sixth week), — a mortality of 7.7 per cent. In four cases it was used late, and the patients died. Of the 25 in which it was not used, 11 of the patients died.

Everett is a city of new, clean houses. We have a third less tuberculosis than the average of the State. By care and disinfection we can keep these houses free from the germs of this disease.

Fall River.

Many cases of contagious diseases have come under our observation in homes and boarding-houses where there were not proper facilities for their care and isolation. We believe the safety of the public demands that some provision for such cases should be made, and would recommend that a ward in the old almshouse be set apart for the treatment of contagious diseases of this character, other than small-pox.

The increase in contagious diseases for the year, before noted, was altogether confined to scarlet fever and diphtheria, and was not wholly unexpected, as in the early spring and during the year those diseases were reported as prevalent, and even epidemic, in many cities of the Commonwealth as well as the surrounding States, from which the board knows some of the cases reported in this city were brought, and has reason to believe there were others.

Early in the year the board decided that it would be necessary to take energetic measures to stamp out those diseases, or prevent them becoming epidemic, and result in the closing of the public schools, as occurred elsewhere. Regulations were adopted, printed and furnished to all physicians and undertakers, and, through the superintendent of schools, the teachers of the public schools were also notified of the same.

In all cases of diphtheria, culture tubes are furnished by the board to the attending physician, to take cultures from the throat of the patient.

Our only protection against small-pox consists in thorough vaccination. This the board provides free of expense, and advertises freely, which we are gratified to note by the records is understood and appreciated by our cosmopolitan population, the number vaccinated each year exceeding the previous one. Vaccinations are performed by the clerk of the board, under the direction of the city physician. The number successfully vaccinated each year during the past four years was as follows: 1892, 1,326; 1893, 1,231; 1894, 1,720; 1895, 2,118.

While the primitive method of disposing of garbage, as pursued here, might for a time be permitted in a country town, where it could be conveyed to some uninhabited outlying district, it seems needless to add that

it is in no way adapted to a city of ninety thousand inhabitants. With a view to be able to suggest at this time the safest and most approved system of disposing of garbage, the board, agent and inspectors have visited different cities during the year, for the purpose of investigating their systems. The result of our inquiries confirms the opinion that destruction by fire is the only sure and safe method of disposing of garbage.

Ten cows were found to be infected with tuberculosis during the year, and, after the usual quarantine and inspections by the cattle commissioners, were destroyed, and the carcasses disposed of to the satisfaction of the board of health. In May last the board adopted a regulation requiring the owners of all neat cattle within the city to have the same duly registered and licensed at the office of the board of health every year. The reason that led to this was the number of cases coming to our notice of ill-fed cattle, allowed to roam through the streets and feed upon garbage among the different dumps throughout the city, as well as the filthy condition and lack of ventilation in the stables in which they were housed (when housed at all).

Fitchburg.

House inspection has been extended, during the past year, over sections of the city contiguous to those sections inspected in 1894, and has included also the whole section, called the south Fitchburg district, which was the seat of the diphtheria epidemic. The total number of inspections recorded was 554.

The total number of nuisance complaints received by the board during the year was 148. This includes only the complaints of which a record is made. In connection with the regular house inspection, a very large number of minor unsanitary conditions were found and corrected by a personal notice.

The majority of the cases of diphtheria occurred in a section of the city which is in no way provided with sewers and proper means of drainage. It cannot be said, however, that the unsanitary conditions found in nearly every house where the disease occurred were the direct cause of the outbreak, as an infection from case to case was in nearly every instance traced. In all cases where defects were found the property owners were asked to correct them so far as possible, and in nearly every instance they readily and promptly complied. A very good map, showing the location of cases, accompanies the report.

Typhoid fever has been somewhat prevalent during the year, although the total number of cases was not greatly in excess of 1894. Out of a total number of 29 cases, 7 may fairly be said to have been imported,— the origin of the disease having been traced to infection arising in other places than Fitchburg. More than usual care has been exercised the past year in getting as accurate a history of each case as was possible.

Framingham.

The State Board of Health was consulted in reference to the cases of typhoid fever occurring in South Framingham, a suspected well of water was examined, and all infected premises ordered cleaned and disinfected. The outbreak could be traced to two imported cases.

Gardner.

The sanitary condition of the town is the best that it has been within our memory. Places that in former years were frequently neglected are now being regularly attended to, or are improved so as to avoid frequent complaints. We believe that prompt attention to complaints has led to this gratifying result, and the people of the town derive the benefit in being comparatively free from contagious diseases.

With a town of ten thousand inhabitants, the milk supply is one of great importance. Since the board recommended that those furnishing the supply should obtain licenses, we find that there has been a steady improvement in the care of stock, and, the natural result, an improvement in the milk supply. There have been forty-eight licenses granted during the past year.

Gloucester.

There have been more cases of scarlet fever and diphtheria during the past year than on some previous years, but the type has generally been mild.

The board would recommend the maintenance of a hospital for contagious diseases.

Haverhill.

The most noticeable contrast in the mortality of any infectious disease between last year and previous years is the number of fatal cases of whooping-cough. Physicians are very careful to report their cases of diphtheria and scarlet fever, but little attention is paid to reporting cases of whooping-cough. The records show that only 34 cases have been reported, and of this number 12 deaths occurred last year. This would be more than 35 per cent. of the number reported, — a higher death rate than any other disease that was reported to us. It is probable that, instead of there being but 34 cases, as reported, in the city last year, there were many times more than that number. In the last twelve years, including 1895, there have been, in all, but 31 fatal cases of whooping-cough, an annual average of less than 3 deaths.

Holyoke.

The board is of the opinion that a crematory necessary for the accommodation of the city's offal, and located in a convenient place, would be more economical to the city than the course now pursued.

Early in May a thorough health inspection of the city was made by the board of health. Several localities of doubtful healthfulness were promptly corrected in a measure satisfactory to the board. The importance of this annual sanitary inspection regularly and systematically carried out in the early season of each year cannot be over-estimated. It stimulates the habitually careless to a better regulation of their houses, and removes from unsanitary localities much that invites and fosters disease germs for summer activity. On persons not complying with the board's orders in regard to abating nuisance, eight sheriff's notices were served; conviction and fine was the result of each case.

Out of a mortality of 111 deaths during the month of July, 79 deaths were among infants.

Hyde Park.

About one hundred and fifty complaints have been received in relation to overflowing cesspools, vaults in bad condition, wet land, filthy houses and yards, dead animals, and swine kept without permits.

There has been quite an increase in the cases of contagious diseases, although in some respects we have fared better than some of the towns about us. The increase in cases of measles has given a large total for this year. We find that in cities and towns where a hospital is provided patients receive in most cases better care, the contagion is less liable to spread and deaths are less frequent. We hope the time will come when we can have this help in our work.

Ipswich.

During the months of October and November an epidemic of measles spread through the town. The disease was of a mild type, and no deaths occurred from the same. With these exceptions, the general health of the town has been fairly good. But how much longer this will continue is a question, and one to be seriously considered; for with our public water supply and our town being so situated in a valley, so to speak, and our drainage at the best none too good, the filth that will accumulate in numerous cesspools will prove a dangerous menace to the public health. The complaints to the board for the past year have been mostly from this cause, and absolute safety from cesspool filth will never be attained until the town provides a system of sewerage.

Lee.

The board as a body, or by delegating one of its members, investigated all complaints received regarding nuisances or conditions detrimental to the public health whenever there seemed reasonable ground for such complaints; and in all cases the recommendations or orders of the board were promptly and apparently cheerfully complied with.

Lexington.

For several years past the piggeries in various parts of the town have at times given considerable trouble. The present board, after careful consideration, adopted the system of giving permits for the keeping of swine, a practice which has thus far given very good satisfaction. The whole number of permits granted is sixteen, the board finding it unnecessary to issue permits for a less number than twenty pigs.

Lowell.

Cost of burning garbage, 1894,	$5,742 69
Cost of burning garbage, 1895,	3,662 53
Saving in 1895 of	$2,080 16

The ashes resulting from the combustion of our garbage have frequently been analyzed at the State Agricultural College at Amherst. The analyses vary, and to a certain extent summer ashes appear to be poorer than those of the spring or fall. The largest amount of potassium oxide per 100 parts contained in a specimen of the ashes was 8.83; the largest amount of phosphoric acid was 32.36.

The only way to obtain a satisfactory solution of the problem, how best to dispose of a city's garbage is to make a thorough personal investigation of all the methods now in use. Such an investigation has been begun under the direction of Mr. Rudolph Hering, the well-known civil engineer, and chairman of the committee on disposal of garbage of the American Public Health Association.

In the mean time, the conclusions reached by the board of health from a three-years study of the subject are briefly as follows: —

That reduction systems, even if well located, properly constructed and properly managed, can at present offer no marked improvement over crematories.

That, at present, cremation is the best solution of the problem for the average New England city. That the kind of cremator to be selected

should have been in active operation for at least a year in some city where it has caused no nuisance.

That trustworthy figures should be obtained as to the average cost in fuel and labor to burn a ton of garbage, and that the price of fuel and labor should be known.

That that cremator should be selected which, considering the original cost, will do the city's work most efficiently and economically.

That it should be owned and operated by the city.

That the cremator now in use in Lowell is a vast improvement over the methods employed in all other New England cities.

A contagious disease hospital is recommended.

The board of health recommends, and the citizens can if they desire see, that Lowell is provided with a public bath-house.

As regards the use of antitoxin in diphtheria, we find from our limited experience somewhat more favorable results from the use of the remedy than by other means of treatment.

Lynn.

During the year there has been completed on Holyoke Street a hospital for contagious diseases, in accordance with chapter 511 of the Acts of 1894. This property was turned over to the board of health by the proper committee April 29, 1895. It was dedicated and opened to the admission of patients May 15, 1895, the administration building and two hospital wings, consisting of two wards each, receiving suitable furniture throughout as a gift.

The first patient was admitted June 13, and the total number admitted to Jan. 1, 1896, was 40. The first case of scarlet fever was admitted June 13, and the number of cases was 12. The first case of diphtheria was admitted August 14, and the number of cases was 27. One case of measles was admitted July 7. Of the 40 patients admitted, there have been 3 deaths, all from diphtheria, or about 11 per cent. of the diphtheria cases admitted, or a little more than 7 per cent. of total admissions.

As soon as possible after a patient suffering with diphtheria has been admitted to the hospital diphtheria antitoxin is administered, which has a pronounced curative effect upon the disease. The use of this remedy is responsible for making the mortality so low the past six months in this institution. In two of the patients that died the disease had been in progress six days before the remedy was administered. In the third patient, beside being a late stage of the disease, there was some complication which was not positively recognized. The first two patients died twenty-four and thirty-six hours after admission, and the third thirty-six hours after admis-

sion. To my mind, all three of these patients could have lived had the administration of antitoxin been effected in the early stages. Comparing this experience with that had in 1893, when diphtheria appeared in the children's home, there were 3 deaths in 10 taken with the disease, or a mortality of 30 per cent.; this was before antitoxin was used in this country.

Marlborough.

There has been no serious outbreak of disease in the city during the year. In November a rather small epidemic of measles appeared, and about sixty cases were reported to the board.

The cases of scarlet fever and diphtheria were few and somewhat widely separated in time of appearance and in location.

Early in the year the board discussed the matter of furnishing to the physicians of the city means for a culture diagnosis in cases of diphtheria. Although the opportunity to test the value of this method of being positive in diagnosis in cases of contagious disease has been small, there being only nine cases of diphtheria during the year, the board is much pleased at the results of its experience. In the summer vacation a very severe case of diphtheria appeared, after an interval of five months in which no cases had been reported. By chance it was discovered that a boy who had lately come from a neighboring town, from a house where there was a case of diphtheria, was staying on the opposite side of the street. This boy had taken dinner some days previous with the patient now sick with diphtheria. A culture examination of the throat of the suspected importer of the disease showed that his throat contained germs of diphtheria, though he had not at any time been sick in bed nor in doors, nor had he paid any attention to his sore throat. No doubt he was the bearer of the disease to the first-mentioned patient. These cases are mentioned to call the attention of the public to the fact, not generally understood, that a person may be suffering from diphtheria in a mild form, and not necessarily be sick in bed, but at the same time be capable of conveying the disease in its worst form to another individual.

The antitoxin furnished by the State Board of Health was used by the physicians attending diphtheria cases in only two instances. Each time there seemed to be a reluctance on the part of the physician to use the new remedy until other means of treating the disease had been tried. This is not the course recommended by those who are familiar with the best results of antitoxin treatment, and it is hoped that physicians who decide to use antitoxin will give the remedy a fair trial by using it as early in the case as possible.

There were one hundred and seventy-one complaints of nuisances received during the year. These were promptly investigated. A few legal notices were served.

Medford.

In our report of 1894 attention was called to the fact that the existence of diphtheria can be positively recognized at an early stage by the modern methods of microscopical examinations. Following our recommendation, the sum of one hundred dollars for the special purpose of providing such examinations was generously granted, and during the past year thirty-one cultures from suspected cases of throat disease have been examined either at the Harvard or Tufts medical school laboratories, with the following results: number of examinations, 31. The bacillus of diphtheria was found in 23 examinations; the bacillus of diphtheria was not found in 8 examinations. It is thus to be seen that, of 74 cases reported as diphtheria, in fully 50 cases no microscopical examination was made.

In the opinion of this board, each report of a case of diphtheria, with its consequent discomforts of isolation, disinfection, etc., should be founded upon, and verified by, a proper microscopical examination.

Melrose.

Our requirements to correct nuisances have usually been promptly met. One person only has been brought to court and fined for offence, and he for not only emptying his cesspool himself without a permit, but for the gross misdemeanor of pouring the offensive material upon his neighbor's premises. A number of languid responses to our requirements have been wonderfully quickened by the impending resort to legal proceedings.

A concise summary of the labors of the inspector of plumbing during the past year is as follows: —

Number of permits granted to do plumbing,	492
Number of permits for sewer connection,	166
Number of visits made by inspector,	833
Number of water tests made,	424
Number of sewer connections tested,	129

New Bedford.

For the past year every case of typhoid fever, diphtheria and scarlet fever has been investigated, with the idea of keeping a record of each case, and trying to impress upon the public the necessity of greater care in isolation and sanitation.

The school which each child attends is ascertained, together with the special room, and if several cases are found originating at about the same time in any one room, then that room is closed and thoroughly disinfected, and reopened again at the judgment of the board of health. Three times during the past year this has been done, probably stopping what at first

appeared to be the beginning of a serious epidemic of scarlet fever and diphtheria. The Sunday-school attended by the sick child is also inquired into, and the superintendent of that school notified of the fact of that child's illness, with the advice to stop future attendance of other children in the same family. Each case of scarlet fever is watched until desquamation has ceased, although no school permits are given until after four weeks have elapsed, even though that process should have apparently ceased earlier.

During the year about 550 calls have been made by the inspector. Nineteen vessels coming from foreign ports boarded by quarantine physician; none quarantined.

Newton.

Upon recommendation of His Honor the mayor, the city council, in June, appropriated the sum of one thousand dollars for the erection and maintenance of a bath-house on the bank of Charles River, off California Street, Ward 1. The committee on public property were instructed to erect the building, which, when completed, was to be turned over to this board to maintain.

The general health of the city during 1895 has compared favorably with previous years, the number of deaths being 448, a mortality of 16.23 per thousand. No general epidemic has occurred, although from some of the wards a large number of contagious cases were reported. The three important contagious diseases, diphtheria, scarlet fever and measles, have been present in the city almost continuously during the year, but never in such number as to cause serious alarm. As will be seen by the tables, the number of cases of diphtheria reported to the board was greatly in excess of the previous year.

The great benefit to the city of the contagious wards of the Newton Hospital has again been fully demonstrated, 121 cases of contagious disease having been admitted. The board has always urged, and in some cases compelled, parents to send their sick children to the hospital. This is one of those instances when the prerogative of the board seems to antagonize individual liberty; but it is the duty of a board of health to do all in its power to prevent the spread of a contagious disease, and, as by removing a sick person from a crowded tenement more can be done toward freeing the community from danger than can be accomplished by the strictest quarantine, the individual must yield to the community.

The plan of appointing medical inspectors for each ward or school district, on whom the board can call to examine the children in a school or elsewhere, in the event of suspected cases, has worked most satisfactorily. Several school inspections have been made, and a large number of children have been examined at their own homes by the inspectors; in several instances unsuspected cases of disease have been discovered and reported to

the board, thus enabling it to take proper precautions. No complaint in regard to the interference by the inspectors with the work of the family physician has been reported, and the board will continue the system during the coming year.

On Jan. 1, 1895, the board announced that it would furnish antitoxin free of charge to physicians who wished to use it in the treatment of diphtheria. Advantage was immediately taken of this offer, and the board continued to supply it until the State Board of Health was able to meet all demands.

The use of antitoxin in the treatment of diphtheria may be said to have become general in Newton after this offer made by the board. Previous to that several cases had been treated with it, but they were too few to permit any inference to be drawn as to its value. Since then the board has endeavored to keep careful statistics of the results of its use, and the figures given herewith are of great interest. To show most conclusively the effect of antitoxin upon the death rate in diphtheria, it is necessary to compare the rate in 1895 with that of previous years. Starting in 1890, it is found that the death rate from diphtheria in Newton is as follows: —

Year.	Cases.	Deaths.	Rate.
1890,	55	10	18.18
1891,	42	7	16.66
1892,	29	8	27.50
1893,	88	32	37.27
1894,	81	20	24.69

The figures for 1895 are as follows: —

1895,	151	15	9.93

In accordance with an order of the city council, the board considered the subject of establishing a steam plant for the disinfection of bedding, mattresses, etc., from houses infected with contagious disease. A report on this subject was made early in the spring, and the board again calls attention to the necessity for such a plant in order to prevent the spread of contagion through the inability of the board to properly disinfect such articles.

Northampton.

We have no hospital for contagious diseases. A suitable location for one has been found in the rear of the almshouse property, across the track, safe from danger of contagion. A one-story wooden building costing but a small sum is needed in our city.

North Attleborough.

North Attleborough has enjoyed a comparative freedom from diseases of a contagious character during the past year. Any cases that have appeared have been quarantined at once, when the board has been notified of their existence. In each case, when quarantined, there has been no spread of the disease beyond the domicile where it first made its appearance. The neglect of one family in failing to ascertain the true character of the sickness of one of its members caused the board to fear that there might follow an epidemic of scarlet fever, since the child had been allowed to mingle with other children. Fortunately, only one other case followed as a result of this neglect. The board feels called upon to once more demand of parents that they should consult some competent authority in case of any suspicious sickness, especially among children.

Provincetown.

The inspectors of the board of health have visited about eight hundred houses, and in nearly all found marked improvement in condition over last year. We have also visited the schools, and found the temperature quite even, but the system of ventilation very poor indeed, and would recommend that it be improved in some way during the coming year.

The vaccination law has been thoroughly enforced in our schools, with the result that over four hundred children have been vaccinated; each of these, together with all those who had been previously vaccinated, was presented with a certificate to be given to the superintendent, that a thorough and complete record may be kept of the same.

Quincy.

One of the earliest matters to receive the attention of the board was the importance of improving the scavenger system of the city. Complaints by citizens and the personal knowledge of the workings of the old system led the board to consider the desirability of adopting a more cleanly and responsible system than had previously prevailed. Testimonials and visits to neighboring cities where the contemplated system was in practical working order led the board to adopt the Odorless Excavating Company's system.

Salem.

In two cases this year it has been necessary to close schools until a complete disinfection could be had, and books, pencils, etc., likely to spread the infection, destroyed. So little did some persons realize the importance of thus protecting the children, that some adverse criticism followed because of the loss of the value of the books, which, however, was quite inconsiderable.

The board has encouraged in every practicable way the use of the new remedy, antitoxin, and with very gratifying results. The length of the disease, in cases where this remedy was used, has been much reduced, and in some cases lives have been saved which in all probability would have been lost under any other treatment. Of the four fatal cases, two were treated in this way and two were not.

Somerville.

Number of nuisances abated,	814
Number of nuisances referred to board of 1896,	173
Number of nuisances complained of,	987
Number of complaints (many covering more than one nuisance),	507
Number of notices mailed,	480
Number of notices served by constables,	19

In addition to the above, many nuisances have been abated on verbal notice from the agent without action by the board, and of which no record has been made.

Six cases of glanders have occurred during the year. Prompt action was taken in every case, and the horses have been killed.

Taunton.

The board has advocated the isolation of suspected cases of diphtheria, especially where there are two or more children in the family or house, without waiting for a full development of the disease.

Early in the year the board of health invited the co-operation of the school teachers to aid in preserving the public health. To this end printed postal cards directed to the board of health were distributed to each teacher, whereon they were to indicate the absence of any pupil with suspected illness. Upon receipt of the card the physician of the board visited the scholar. A large number of cases so indicated have been examined, and, while a large majority of cases found were of the kind incident to childhood, suspicious cases of contagious disease have been found, the child isolated and children in the house kept from school.

Wakefield.

Regulations for the inspection and testing of plumbing work were made and have been enforced. The result has been highly satisfactory, the quality of the work done being so much improved as to far outweigh the additional cost to the town of having the inspections made. We wish to impress upon the town the absolute necessity of some sewerage system in the very immediate future, as there are in certain portions of the town nuisances that cannot be entirely abated under present conditions.

Waltham.

The careful precautions taken in regard to suspicious throat cases have been observed throughout the year. Cultures have been taken from all suspicious cases, at the request of the physician in charge, and quite a number of cases that would have passed as non-contagious were proved contagious and properly isolated.

No case of diphtheria has been let out of quarantine until a bacteriological test of the throat has proved the absence of the diphtheria bacillus. During the year 605 cultures have been taken, and the result of the bacteriological examination communicated to the physician in charge. The bacteriological laboratory of the Waltham Hospital has continued to serve the city by freely accommodating the board of health. There were 115 cases of diphtheria during the year, with 3 deaths, giving a very low mortality rate, which remarkable result was evidently due to the beneficial action of antitoxin, and also to the many mild cases which might have passed unnoticed but for the bacteriological test.

At the beginning of the present year this board notified the physicians of Waltham that free examinations of sputum for the bacilli of tuberculosis would be made by the physician of the board. As a result 52 specimens of sputum were sent to the board, and a careful microscopic examination made. The board also offered to disinfect after the death or removal of cases of consumption, when requested to do so by the physician in charge or the family.

In June, 1895, a somewhat different process of disinfection of rooms and furniture was begun. Reliance is no longer placed in fumigation, but in the most painstaking cleansing of every part of the room and furniture. Five per cent. solution of carbolic acid is used as a germicide. The city is in great need of a disinfecting station, where clothing and bedding can be disinfected by dry or superheated steam.

Watertown.

For the first time the care of all sanitary matters, which includes the bath-house, was assumed by the board of health. It was thought wise in the management of the bath-house to reserve it two afternoons a week for the use of women. For that purpose a woman was appointed to take charge of the bath-house during those afternoons. The plan has worked well and will be continued.

During the year the connection of all available premises with the common sewer has progressed very favorably. At every meeting of the board of health a number of premises have been ordered to be connected with the sewer, and almost uniformly the requests of the board have been complied with.

Westfield.

One hundred and eighty-nine nuisances have been abated during the year. Fifteen water-closets so located as to be considered nuisances have been ordered connected with the sewer.

We feel that the time has fully come when responsible persons should be employed to remove garbage from the streets and yards at least three times a week during the warm season.

Westford.

The use of antitoxin both as a cure and preventive of diphtheria has come into prominence and considerable use. We have been able to arrange for a supply from the State Board of Health through the city of Lowell, and in all necessary cases it can be used. Five patients have been treated with it during the year, with the following results: 2 cases membranous croup (diphtheritic), 1 recovery; 1 case diphtheria, recovery; 2 cases as a preventive, successful.

Whitman.

During the past year seventy-three complaints were entered and attended to, thirty-six quarantine cards posted, and many other calls made and places investigated where no complaints have been made.

The row of dwelling-houses on Park Avenue, back of which lies Hobart's Pond, were nearly all found to be emptying their sink waste and sewage directly into the pond. Such a condition is in direct opposition to the laws of the State as well as public safety, hence the nuisance was discontinued.

Woburn.

The use of antitoxin was introduced and supplied free of charge to physicians who wished to use it in their practice. Its use has become general in Woburn, and the results are very satisfactory to the board. There is no doubt in the minds of the members of the board of health that its timely use has prevented an alarming death rate from diphtheria in Woburn during the last four months of the year.

Worcester.

Number of complaints for the year ending Dec. 31, 1895, 1,602.

Nearly seven hundred cultures have been examined during the year, showing how largely physicians have availed themselves of the use of this department.

The city council selected and purchased a lot for an isolation hospital.

The office of the board is now open every day in the year; the hours Sundays and holidays are between 12 and 1 P.M. It was found necessary to make this addition to the office hours in order that the undertakers should be subjected to no delay in procuring burial permits, and also that culture tubes for diphtheria might be provided for and received from physicians.

The following group of figures presents the general death rate per 1,000, and the combined death rate per 10,000, from scarlet fever, diphtheria and croup, typhoid fever, cholera infantum and consumption, in a group of contiguous towns lying mostly in the metropolitan district, and for a period of four years, 1891–94. None of the number had a general death rate of more than 20 per 1,000, and the mean annual death rate of the group was 17.1 per 1,000 of the estimated living population.

Four Years (1891–94).

	General Death Rate per 1,000.	Death Rate from Infectious Diseases.
Reading,	15.9	2.7
Stoneham,	14.8	3.4
Melrose,	15.1	3.6
Wakefield,	16.7	3.8
Malden,	17.1	3.8
North Reading,	19.0	4.1
Saugus,	19.8	4.2
Woburn,	19.5	4.5
Lynnfield,	17.1	5.9
Mean rate for the district,	17.1	3.8

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